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Wiegman

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(54) **CONNECTOR AND METHOD FOR USE FOR AUTHORIZING BATTERY CHARGING FOR AN ELECTRIC VEHICLE**

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(51) **Int. Cl.**

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B60L 53/66	(2019.01)
H02J 7/00	(2006.01)
B60L 53/30	(2019.01)

(52) **U.S. Cl.**

CPC ***B60L 53/16*** (2019.02); ***B60L 53/305*** (2019.02); ***B60L 53/65*** (2019.02); ***B60L 53/66*** (2019.02); ***H02J 7/00034*** (2020.01)

(58) **Field of Classification Search**

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USPC 320/109
See application file for complete search history.

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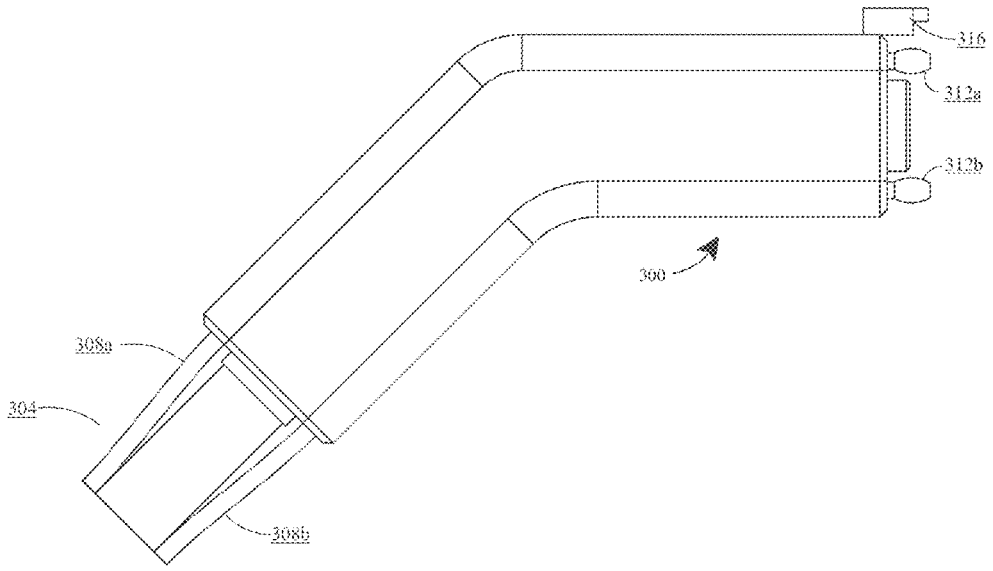
(57) **ABSTRACT**

A connector for charging an electric vehicle that includes a housing configured to mate with an electric vehicle port of an electric vehicle, at least a sensor configured to detect an attachment datum as a function of the housing mating with an electric vehicle port, and transmit the attachment datum to a computing device, a computing device configured to receive the attachment datum from the at least a sensor, receive an identification datum from the electric vehicle, generate a verification datum as a function of the identification datum and the attachment datum, and determine an authorization status as a function of the verification datum.

17 Claims, 9 Drawing Sheets



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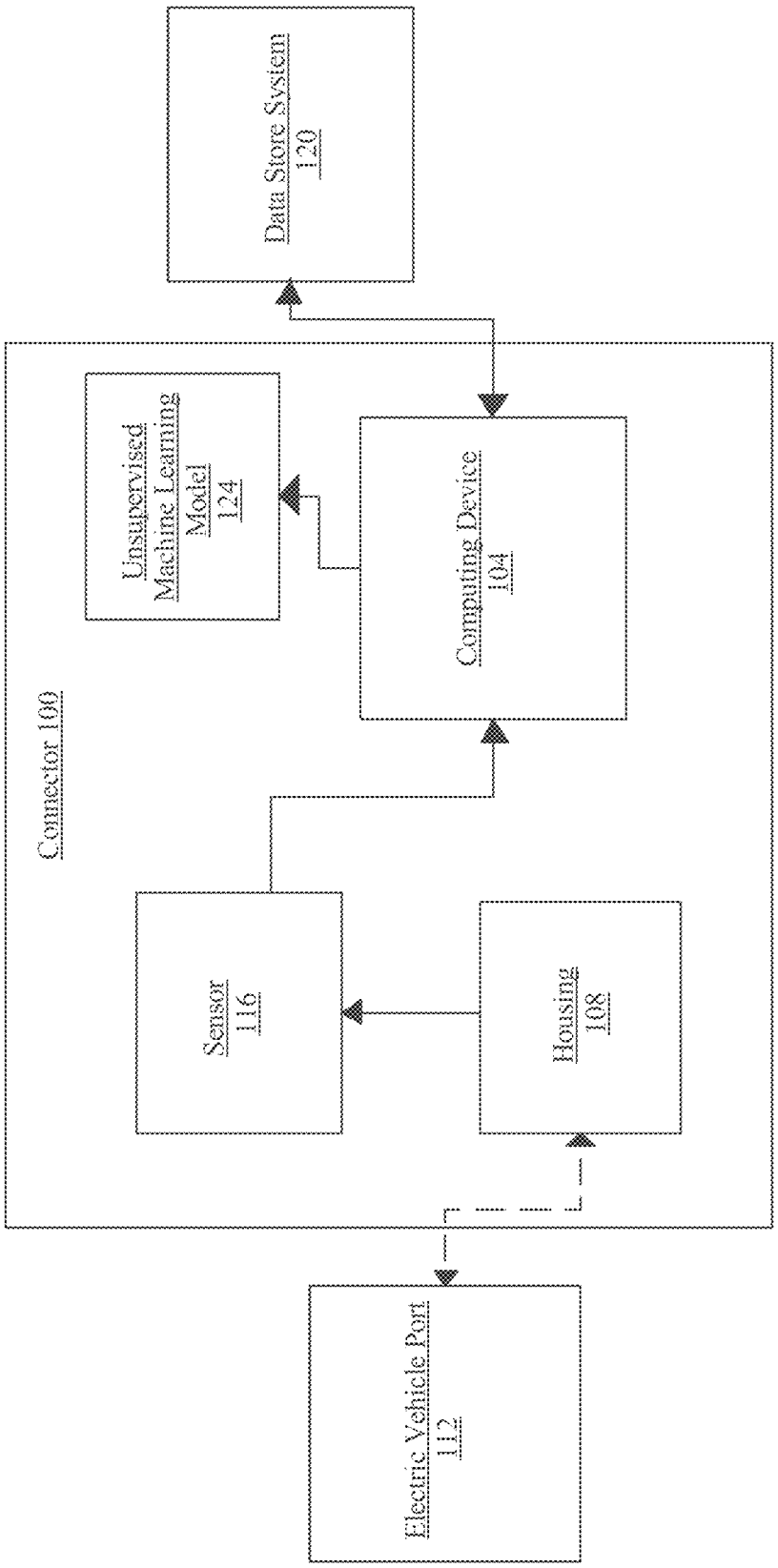
Data Store System
120
Unsupervised
Machine Learning
Model
124
Computing Device
104
Connector 100
Sensor
116
Housing
108
Electric Vehicle Port
112

FIG. 1

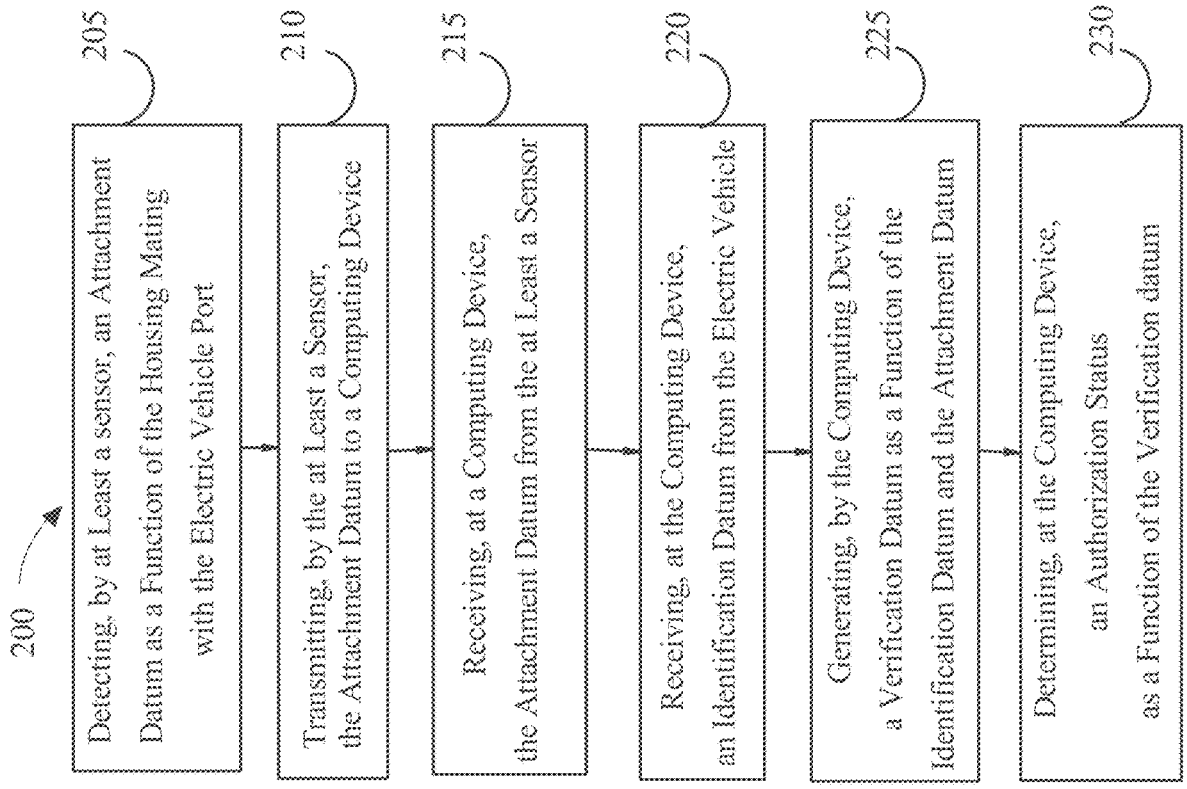
200
205
Detecting, by at Least a sensor, an Attachment Datum as a Function of the Housing Mating with the Electric Vehicle Port
210
Transmitting, by the at Least a Sensor, the Attachment Datum to a Computing Device
215
Receiving, at a Computing Device, the Attachment Datum from the at Least a Sensor
220
Receiving, at the Computing Device, an Identification Datum from the Electric Vehicle
225
Generating, by the Computing Device, a Verification Datum as a Function of the Identification Datum and the Attachment Datum
230
Determining, at the Computing Device, an Authorization Status as a Function of the Verification datum

FIG. 2

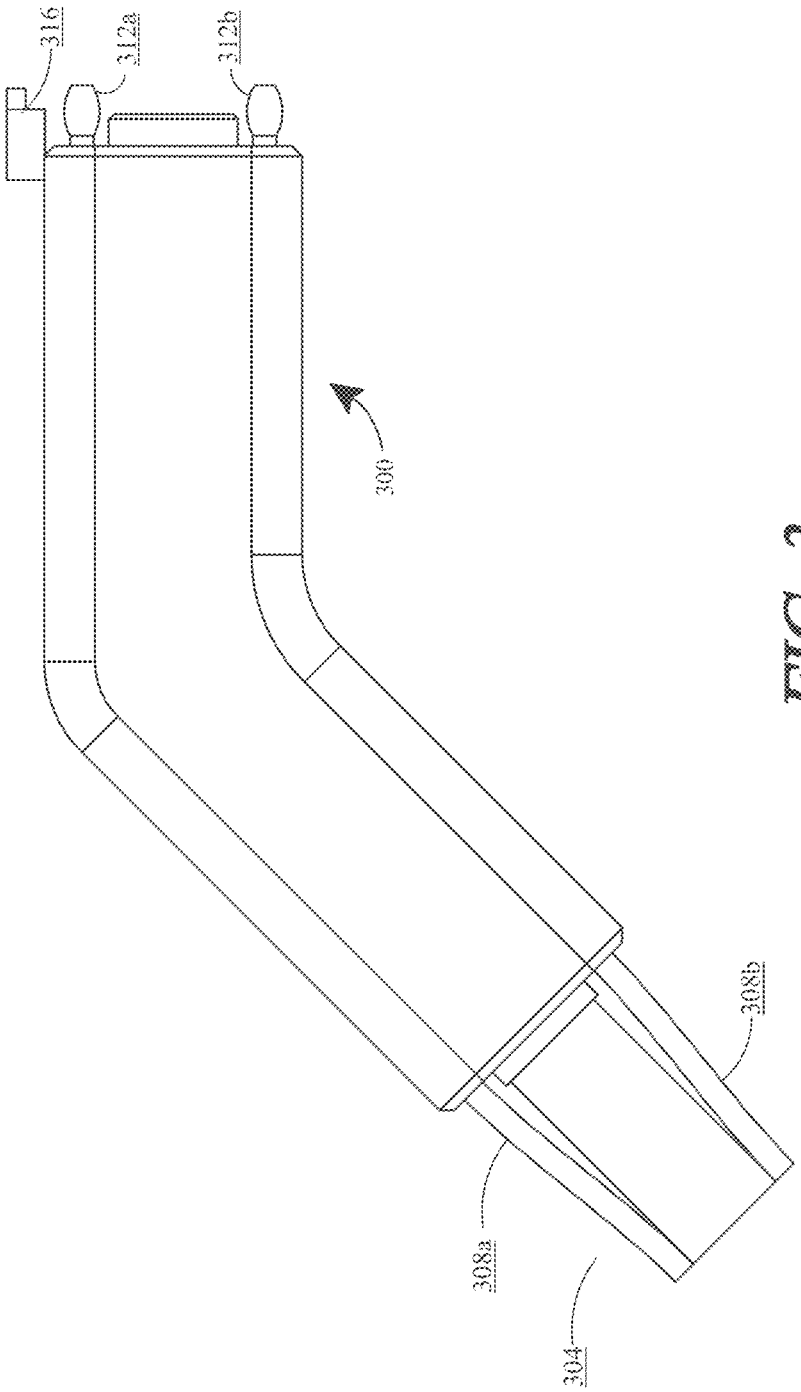

FIG. 3

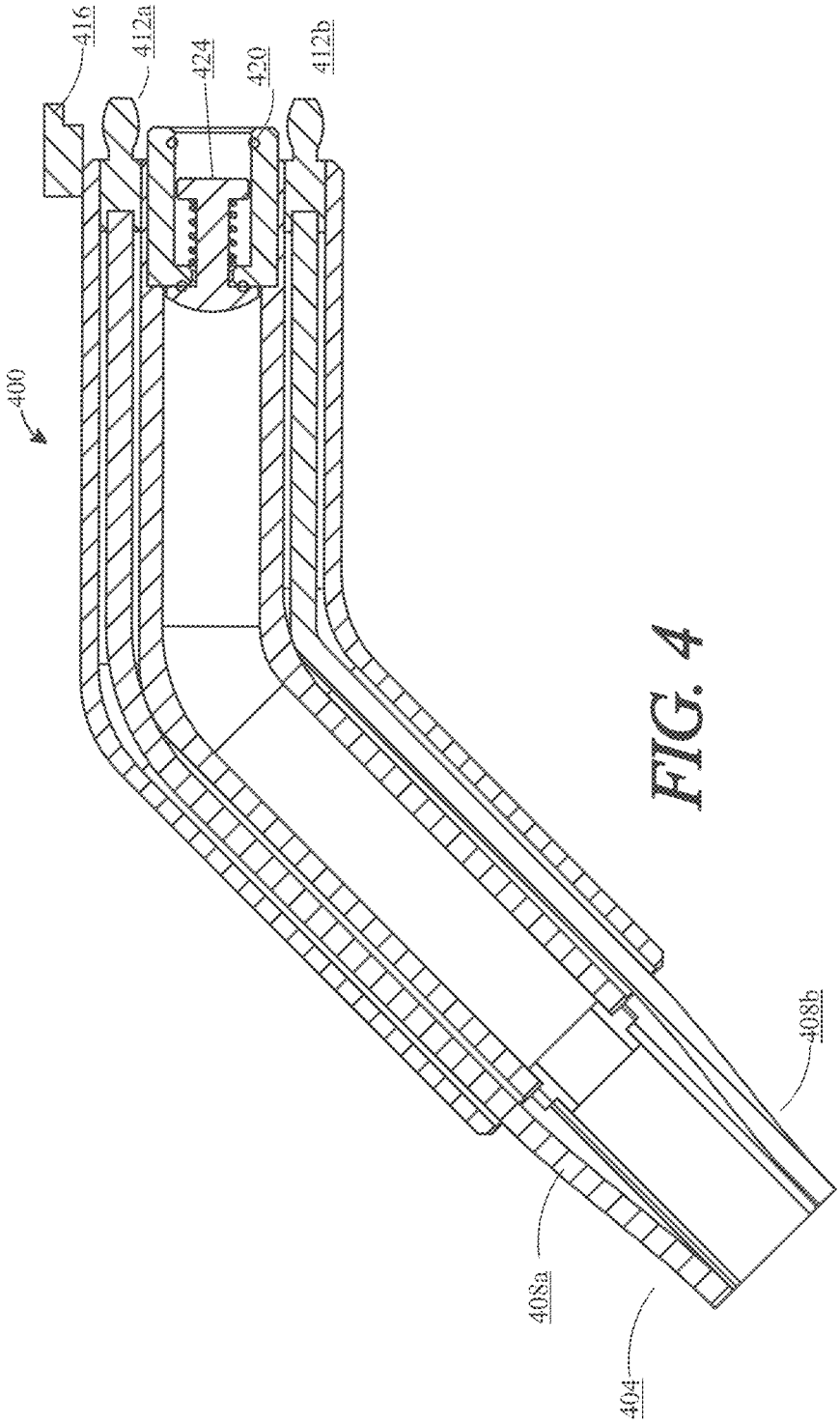

FIG. 4

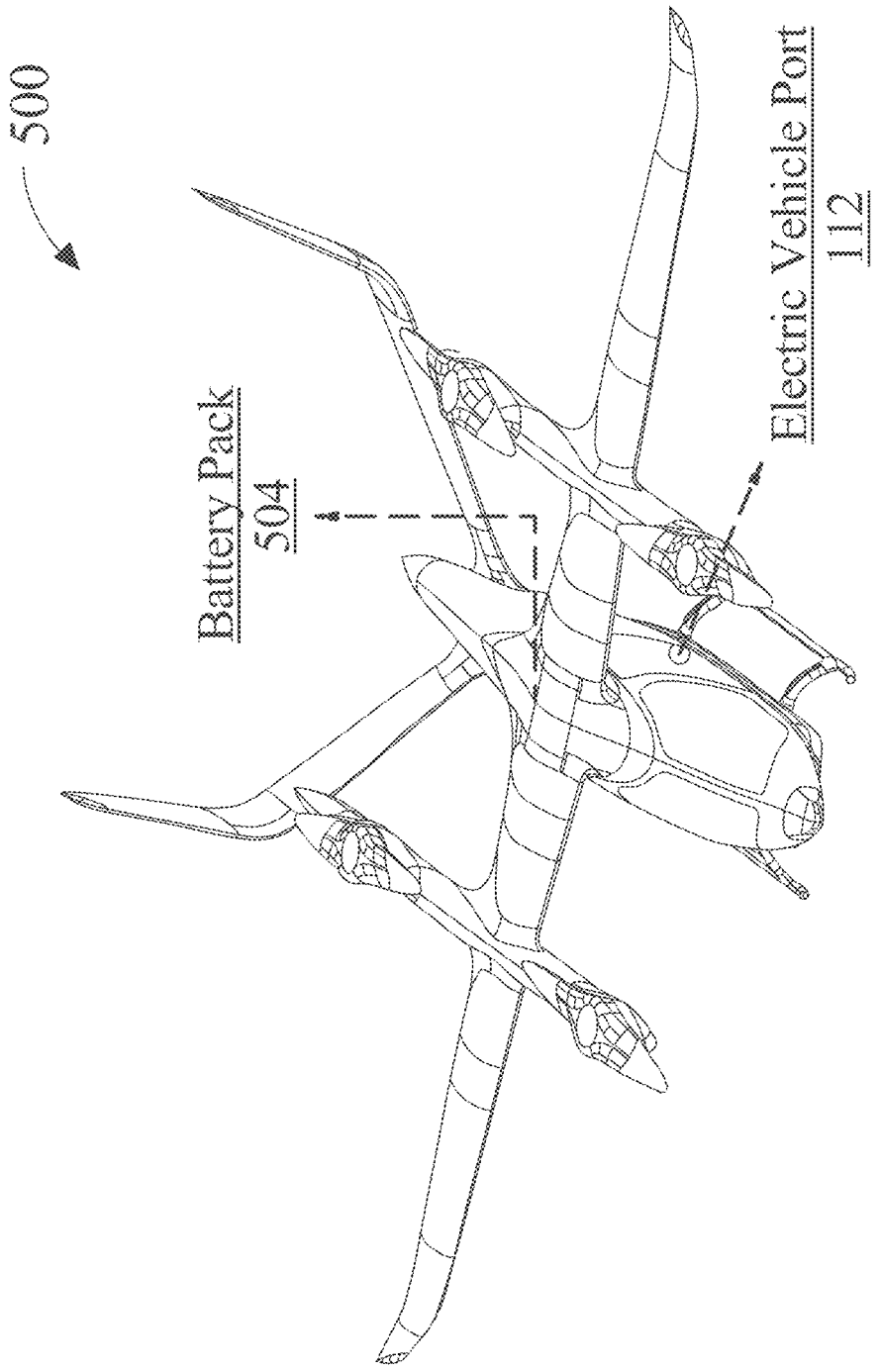

FIG. 5

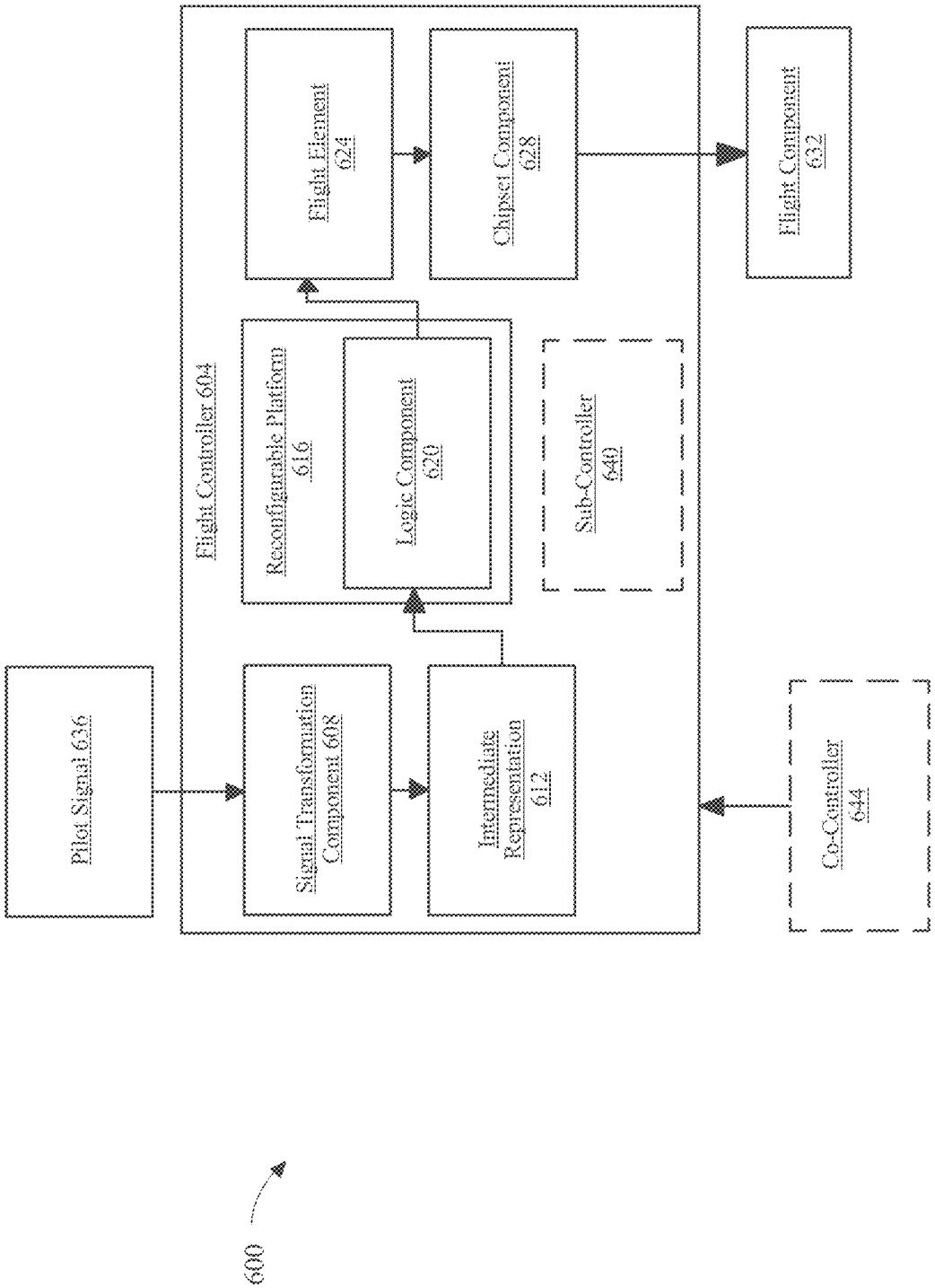
600
Pilot Signal 636
Flight Controller 604
Signal Transformation Component 608
Intermediate Representation 612
Reconfigurable Platform 616
Logic Component 620
Sub-Controller 640
Flight Element 624
Chipset Component 628
Flight Component 632
Co-Controller 644

FIG. 6

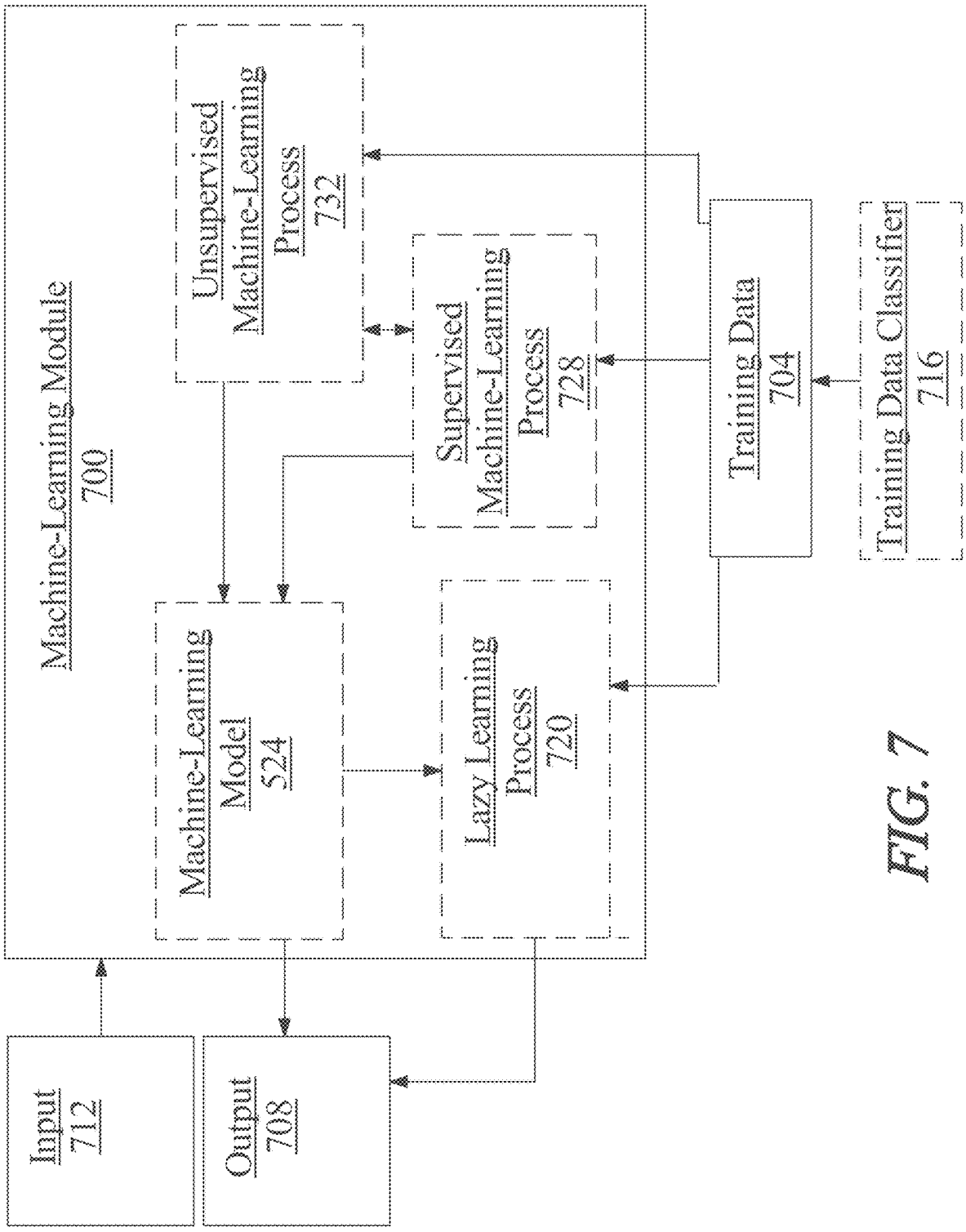
Machine-Learning Module
700
Unsupervised Machine-Learning Process
732
Supervised Machine-Learning Process
728
Machine-Learning Model
524
Lazy Learning Process
720
Training Data
704
Training Data Classifier
716
Input
712
Output
708

FIG. 7

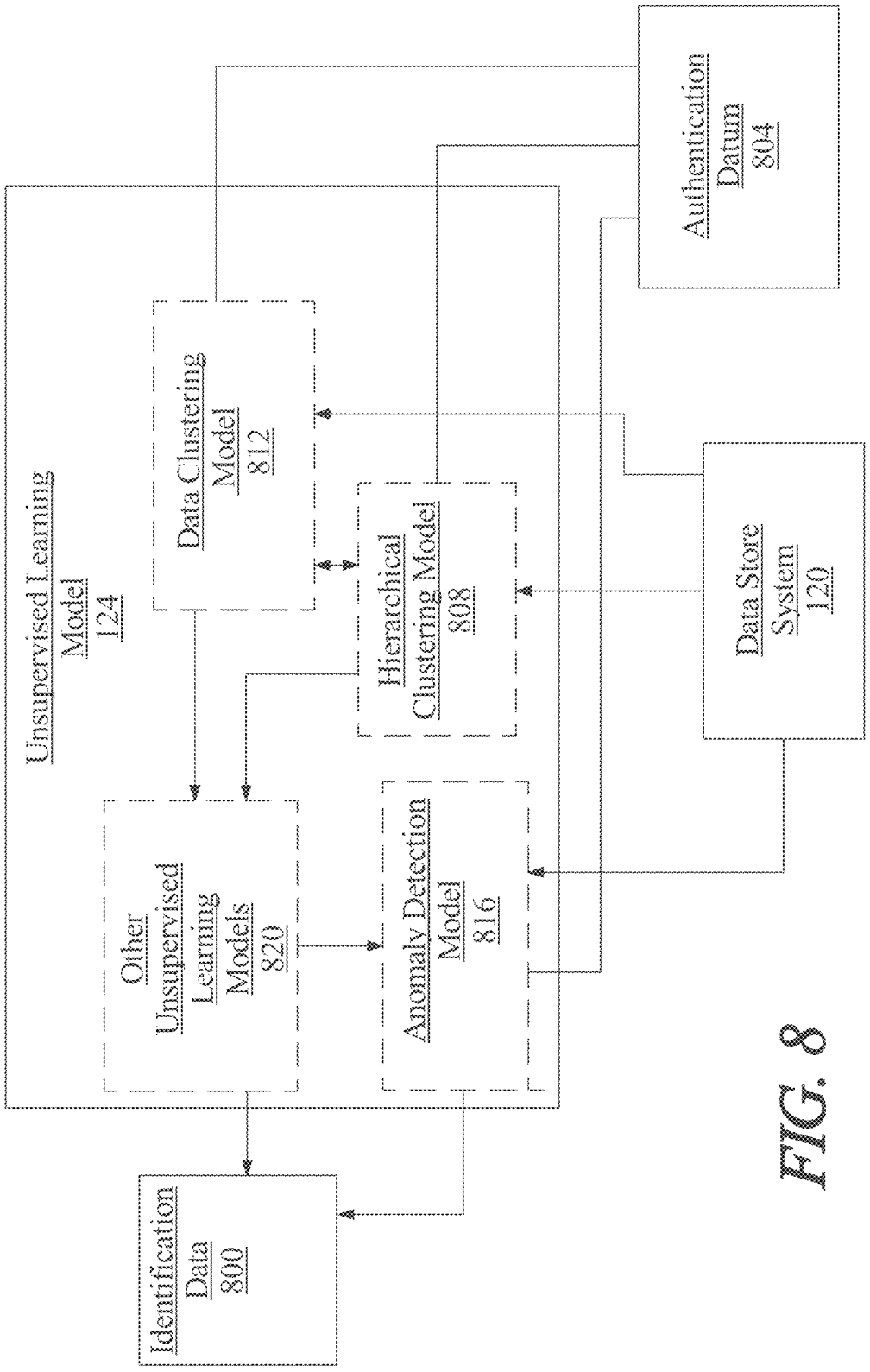
Unsupervised Learning Model 124
Data Clustering Model 812
Hierarchical Clustering Model 808
Other Unsupervised Learning Models 820
Anomaly Detection Model 816
Authentication Datum 804
Data Store System 120
Identification Data 800

FIG. 8

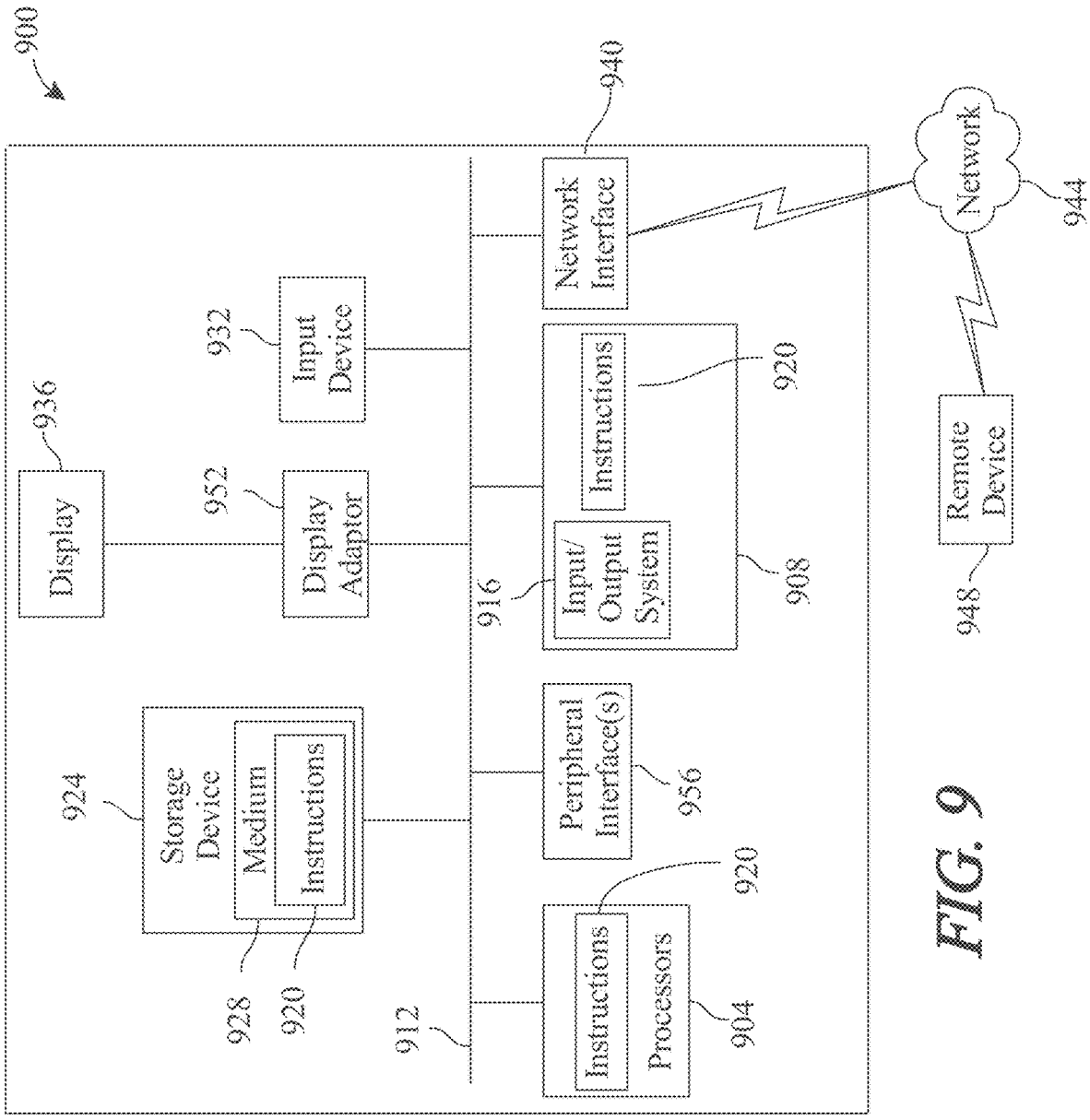
900
940
Network Interface
Network
944
932
Input Device
936
Display
952
Display Adaptor
920
Instructions
916
Input/ Output System
908
948
Remote Device
924
Storage Device
Medium
Instructions
928
920
912
Peripheral Interface(s)
956
920
Instructions
Processors
904

FIG. 9

CONNECTOR AND METHOD FOR USE FOR AUTHORIZING BATTERY CHARGING FOR AN ELECTRIC VEHICLE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of Non-provisional application Ser. No. 17/407,358, filed on Aug. 20, 2021, and titled "A CONNECTOR AND METHOD FOR AUTHORIZING BATTERY CHARGING IN AN ELECTRIC VEHICLE," which is incorporated by reference herein in its entirety.

FIELD OF THE INVENTION

The present invention generally relates to the field of electric vehicles. In particular, the present invention is directed to a connector and method for authorizing battery charging in an electric vehicle.

BACKGROUND

Electric vehicles allow for a quiet and efficient experience, while not requiring fossil fuels. As infrastructure around charging electric vehicles grow, it is desirable to ensure that the vehicle being charged is authorized to do so.

SUMMARY OF THE DISCLOSURE

In an aspect a connector for charging an electric vehicle that includes a housing configured to mate with an electric vehicle port of an electric vehicle, at least a sensor configured to detect an attachment datum as a function of the housing mating with electric vehicle port, and transmit the attachment datum to a computing device, a computing device configured to receive the attachment datum from the at least a sensor, receive an identification datum from the electric vehicle, generate a verification datum as a function of the identification datum and the attachment datum, and determine an authorization status as a function of the verification datum.

In another aspect a method for authorizing battery charging in an electric vehicle that includes detecting, by at least a sensor, an attachment datum as a function of the housing mating with the electric vehicle port, transmitting, by the at least a sensor, the attachment datum to a computing device, receiving, at a computing device, the attachment datum from the sensor, receiving, at the computing device, an identification datum from the electric vehicle, generating, at the computing device, a verification datum as a function of the identification datum and the attachment datum, and determining, at the computing device, an authorization status as a function of the verification datum.

These and other aspects and features of non-limiting embodiments of the present invention will become apparent to those skilled in the art upon review of the following description of specific non-limiting embodiments of the invention in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

For the purpose of illustrating the invention, the drawings show aspects of one or more embodiments of the invention. However, it should be understood that the present invention is not limited to the precise arrangements and instrumentalities shown in the drawings, wherein:

FIG. **1** is an exemplary block diagram for a connector for charging an electric vehicle;

FIG. **2** is an illustrative flow diagram of a method for authorizing battery charging in an electric vehicle;

FIG. **3** illustrates an exemplary schematic of an exemplary connector for charging an electric vehicle;

FIG. **4** is a cross-sectional view of an exemplary schematic of an exemplary connector for charging an electric vehicle;

FIG. **5** is an exemplary representation of an electric aircraft;

FIG. **6** is an exemplary diagram of a flight controller;

FIG. **7** is illustrative embodiment of a machine learning model;

FIG. **8** is a schematic representation illustrating an embodiment of a clustering unsupervised machine-learning model;

FIG. **9** is a block diagram of a computing system that can be used to implement any one or more of the methodologies disclosed herein and any one or more portions thereof.

The drawings are not necessarily to scale and may be illustrated by phantom lines, diagrammatic representations and fragmentary views. In certain instances, details that are not necessary for an understanding of the embodiments or that render other details difficult to perceive may have been omitted.

DETAILED DESCRIPTION

At a high level, aspects of the present disclosure are directed to a connector and method for authorizing battery charging in an electric vehicle. In an embodiment, a method that receives a signal that connector and vehicle are attached from at least a sensor, initiates a connection, receives data identifying the vehicle through the connection, generates a verification signal, such as a voltage that is above a set threshold, and determines whether charging should commence based on that the verification.

Aspects of the present disclosure can be used to ensure only authorized vehicles may be charged. Aspects of the present disclosure can also be used to start or stop charging based on information gathered about the vehicle. This is so, at least in part, because the connector is configured to verify the information gathered from the vehicle against some authenticating database, such as a certificate authority, signal to start charging is only generated if vehicle is authorized to use charger.

Aspects of the present disclosure allow for also using stronger authentication such as requiring a user to also provide information through a smartphone. Exemplary embodiments illustrating aspects of the present disclosure are described below in the context of several specific examples.

Referring now to FIG. **1**, an exemplary embodiment of a connector **100** for charging in an electric vehicle is illustrated. As used in this disclosure, a "connector" is a distal end of a tether or a bundle of tethers, e.g., hose, tubing, cables, wires, and the like, which is configured to removably attach with a mating component, for example without limitation a port. As used in this disclosure, a "port" is an interface for example of an interface configured to receive another component or an interface configured to transmit and/or receive signal on a computing device. For example in the case of an electric vehicle port, the port interfaces with a number of conductors and/or a coolant flow path by way of receiving a connector. In the case of a computing device port, the port may provide an interface between a signal and

a computing device. A connector may include a male component having a penetrative form and port may include a female component having a receptive form, receptive to the male component. Alternatively or additionally, connector may have a female component and port may have a male component. In some cases, connector may include multiple connections, which may make contact and/or communicate with associated mating components within port, when the connector is mated with the port. In nonlimiting examples, the connector type may be CHAdeMO, CCSA, J1772, and like.

Still referring to FIG. **1**, connector **100** includes a computing device **104**. Computing device **104** may include any computing device as described in this disclosure, including without limitation a microcontroller, microprocessor, digital signal processor (DSP) and/or system on a chip (SoC) as described in this disclosure. Computing device **104** may include, be included in, and/or communicate with a mobile device such as a mobile telephone or smartphone. Computing device **104** may include a single computing device operating independently, or may include two or more computing device operating in concert, in parallel, sequentially or the like; two or more computing devices may be included together in a single computing device or in two or more computing devices. Computing device **104** may interface or communicate with one or more additional devices as described below in further detail via a network interface device. Network interface device may be utilized for connecting computing device to one or more of a variety of networks, and one or more devices. Examples of a network interface device include, but are not limited to, a network interface card (e.g., a mobile network interface card, a LAN card), a modem, and any combination thereof. Examples of a network include, but are not limited to, a wide area network (e.g., the Internet, an enterprise network), a local area network (e.g., a network associated with an office, a building, a campus or other relatively small geographic space), a telephone network, a data network associated with a telephone/voice provider (e.g., a mobile communications provider data and/or voice network), a direct connection between two computing devices, and any combinations thereof. A network may employ a wired and/or a wireless mode of communication. In general, any network topology may be used. Information (e.g., data, software etc.) may be communicated to and/or from a computer and/or a computing device. Computing device **104** may include but is not limited to, for example, a computing device or cluster of computing devices in a first location and a second computing device or cluster of computing devices in a second location. Computing device **104** may include one or more computing devices dedicated to data storage, security, distribution of traffic for load balancing, and the like. Computing device **104** may distribute one or more computing tasks as described below across a plurality of computing devices of computing device, which may operate in parallel, in series, redundantly, or in any other manner used for distribution of tasks or memory between computing devices. Computing device **104** may be implemented using a "shared nothing" architecture in which data is cached at the worker, in an embodiment, this may enable scalability of system **100** and/or computing device.

With continued reference to FIG. **1**, computing device **104** may be designed and/or configured to perform any method, method step, or sequence of method steps in any embodiment described in this disclosure, in any order and with any degree of repetition. For instance, computing device **104** may be configured to perform a single step or sequence repeatedly until a desired or commanded outcome is achieved; repetition of a step or a sequence of steps may be performed iteratively and/or recursively using outputs of previous repetitions as inputs to subsequent repetitions, aggregating inputs and/or outputs of repetitions to produce an aggregate result, reduction or decrement of one or more variables such as global variables, and/or division of a larger processing task into a set of iteratively addressed smaller processing tasks. Computing device **104** may perform any step or sequence of steps as described in this disclosure in parallel, such as simultaneously and/or substantially simultaneously performing a step two or more times using two or more parallel threads, processor cores, or the like; division of tasks between parallel threads and/or processes may be performed according to any protocol suitable for division of tasks between iterations. Persons skilled in the art, upon reviewing the entirety of this disclosure, will be aware of various ways in which steps, sequences of steps, processing tasks, and/or data may be subdivided, shared, or otherwise dealt with using iteration, recursion, and/or parallel processing. In embodiments, the computing device **104** may include a controller. In embodiments, controller may be coupled to a charging component. In an embodiment, the controller may be a flight controller mechanically coupled to an electric aircraft. Flight controller is described in detail further below.

Continuing to refer to FIG. **1**, connector **100** includes a housing **108** configured to mate with an electric vehicle port of an electric vehicle **112**. As used in this disclosure, a "housing" is a physical component within which other internal components are located. In some cases, internal components with housing will be functional while function of housing may largely be to protect the internal components. Housing and/or connector may be configured to mate with a port, for example an electrical vehicle port **112**. As used in this disclosure, "mate" is an action of attaching two or more components together. As used in this disclosure, an "electric vehicle port" is a port located on an electric vehicle **116**. As used in this disclosure, an "electric vehicle" is any electrically power means of human transport, for example without limitation an electric aircraft or electric vertical take-off and landing aircraft. In some cases, an electric vehicle will include an energy source configured to power at least a motor configured to move the electric vehicle.

Still referring to FIG. **1**, connector **100** may include a fastener. As used in this disclosure, a "fastener" is a physical component that is designed and/or configured to attach or fasten two (or more) components together. Connector may include one or more attachment components or mechanisms, for example without limitation fasteners, threads, snaps, canted coil springs, and the like. In some cases, connector may be connected to port by way of one or more press fasteners. As used in this disclosure, a "press fastener" is a fastener that couples a first surface to a second surface when the two surfaces are pressed together. Some press fasteners include elements on the first surface that interlock with elements on the second surface; such fasteners include without limitation hook-and-loop fasteners such as VELCRO fasteners produced by Velcro Industries B.V. Limited Liability Company of Curacao Netherlands, and fasteners held together by a plurality of flanged or "mushroom"-shaped elements, such as 3M DUAL LOCK fasteners manufactured by 3M Company of Saint Paul, Minnesota. Press-fastener may also include adhesives, including reusable gel adhesives, GECKSKIN adhesives developed by the University of Massachusetts in Amherst, of Amherst, Massachusetts, or other reusable adhesives. Where press-fastener

includes an adhesive, the adhesive may be entirely located on the first surface of the press-fastener or on the second surface of the press-fastener, allowing any surface that can adhere to the adhesive to serve as the corresponding surface. In some cases, connector may be connected to port by way of magnetic force. For example, connector may include one or more of a magnetic, a ferro-magnetic material, and/or an electromagnet. Fastener may be configured to provide removable attachment between connector **108** and at least a port, for example electrical vehicle port **112**. As used in this disclosure, "removable attachment" is an attributive term that refers to an attribute of one or more relata to be attached to and subsequently detached from another relata; removable attachment is a relation that is contrary to permanent attachment wherein two or more relata may be attached without any means for future detachment. Exemplary non-limiting methods of permanent attachment include certain uses of adhesives, glues, nails, engineering interference (i.e., press) fits, and the like. In some cases, detachment of two or more relata permanently attached may result in breakage of one or more of the two or more relata.

With continued reference to FIG. **1**, connector **100** may include at least one conductor having a distal end approximately located within connector **100**. As used in this disclosure, a "conductor" is a component that facilitates conduction. As used in this disclosure, "conduction" is a process by which one or more of heat and/or electricity is transmitted through a substance, for example when there is a difference of effort (i.e., temperature or electrical potential) between adjoining regions. In some cases, a conductor **120** may be configured to charge and/or recharge an electric vehicle. For instance, conductor **120** may be connected to a power source **124** and conductor may be designed and/or configured to facilitate a specified amount of electrical power, current, or current type. For example, a conductor **120** may include a direct current conductor **120**. As used in this disclosure, a "direct current conductor" is a conductor configured to carry a direct current for recharging an energy source. As used in this disclosure, "direct current" is one-directional flow of electric charge. In some cases, a conductor may include an alternating current conductor. As used in this disclosure, an "alternating current conductor" is a conductor configured to carry an alternating current for recharging an energy source. As used in this disclosure, an "alternating current" is a flow of electric charge that periodically reverse direction; in some cases, an alternating current may change its magnitude continuously with in time (e.g., sine wave).

With continued reference to FIG. **1**, connector **100** may be coupled to a power source mounted configured to provide an electrical charging current. As used in this disclosure, a "power source" is a source of electrical power, for example for charging a battery. In some cases, power source may include a charging battery (i.e., a battery used for charging other batteries. A charging battery is notably contrasted with an electric vehicle battery, which is located for example upon an electric aircraft. As used in this disclosure, an "electrical charging current" is a flow of electrical charge that facilitates an increase in stored electrical energy of an energy storage, such as without limitation a battery. Charging battery may include a plurality of batteries, battery modules, and/or battery cells. Charging battery may be configured to store a range of electrical energy, for example a range of between about 5 KWh and about 5,000 KWh. Power source may house a variety of electrical components. In one embodiment, power source may contain a solar inverter. Solar inverter may be configured to produce on-site power generation. In one embodiment, power generated from solar inverter may be stored in a charging battery. In some embodiments, charging battery may include a used electric vehicle battery no longer fit for service in a vehicle. Charging battery may include any battery described in this disclosure.

Still referring to FIG. **1**, connector **100** may include a conductor in electric communication with power source. As used in this disclosure, a "conductor" is a physical device and/or object that facilitates conduction, for example electrical conduction and/or thermal conduction. In some cases, a conductor may be an electrical conductor, for example a wire and/or cable. Exemplary conductor materials include metals, such as without limitation copper, nickel, steel, and the like. As used in this disclosure, "communication" is an attribute wherein two or more relata interact with one another, for example within a specific domain or in a certain manner. In some cases communication between two or more relata may be of a specific domain, such as without limitation electric communication, fluidic communication, informatic communication, mechanic communication, and the like. As used in this disclosure, "electric communication" is an attribute wherein two or more relata interact with one another by way of an electric current or electricity in general. As used in this disclosure, "fluidic communication" is an attribute wherein two or more relata interact with one another by way of a fluidic flow or fluid in general. As used in this disclosure, "informatic communication" is an attribute wherein two or more relata interact with one another by way of an information flow or information in general. As used in this disclosure, "mechanic communication" is an attribute wherein two or more relata interact with one another by way of mechanical means, for instance mechanic effort (e.g., force) and flow (e.g., velocity).

In some embodiments, and still referring to FIG. **1**, power source may have a continuous power rating of at least 350 kVA. In other embodiments, power source may have a continuous power rating of over 350 kVA. In some embodiments, power source may have a battery charge range up to 950 Vdc. In other embodiments, power source may have a battery charge range of over 950 Vdc. In some embodiments, power source may have a continuous charge current of at least 350 amps. In other embodiments, power source may have a continuous charge current of over 350 amps. In some embodiments, power source may have a boost charge current of at least 500 amps. In other embodiments, power source may have a boost charge current of over 500 amps. In some embodiments, power source may include any component with the capability of recharging an energy source of an electric vehicle. In some embodiments, power source may include a constant voltage charger, a constant current charger, a taper current charger, a pulsed current charger, a negative pulse charger, an IUI charger, a trickle charger, and a float charger.

Still referring to FIG. **1**, in some embodiments, connector **100** may additionally be coupled to an alternating current to direct current converter configured to convert an electrical charging current from an alternating current. As used in this disclosure, an "analog current to direct current converter" is an electrical component that is configured to convert analog current to digital current. An analog current to direct current (AC-DC) converter may include an analog current to direct current power supply and/or transformer. In some cases, AC-DC converter may be located within an electric vehicle and conductors may provide an alternating current to the electric vehicle by way of conductors and connector **100**. Alternatively, or additionally, in some cases, AC-DC converter may be located outside of electric vehicle and an

electrical charging current may be provided by way of a direct current to the electric vehicle. In some cases, AC-DC converter may be used to recharge a charging battery. In some cases, AC-DC converter may be used to provide electrical power to one or more of coolant source, power source, and/or computing device **104**. In some embodiments, power source may have a connection to grid power component. Grid power component may be connected to an external electrical power grid. In some embodiments, grid power component may be configured to slowly charge one or more batteries in order to reduce strain on nearby electrical power grids. In one embodiment, grid power component may have an AC grid current of at least 450 amps. In some embodiments, grid power component may have an AC grid current of more or less than 450 amps. In one embodiment, grid power component may have an AC voltage connection of 480 Vac. In other embodiments, grid power component may have an AC voltage connection of above or below 480 Vac. In some embodiments, power source may provide power to the grid power component. In this configuration, power source may provide power to a surrounding electrical power grid.

With continued reference to FIG. **1**, a conductor may include a control signal conductor configured to conduct a control signal. As used in this disclosure, a "control signal conductor" is a conductor configured to carry a control signal between an electric vehicle and a charger. As used in this disclosure, a "control signal" is an electrical signal that is indicative of information. In some cases, a control signal may include an analog signal or a digital signal. In some cases, control signal may be communicated from one or more sensors, for example located within electric vehicle (e.g., within an electric vehicle battery) and/or located within connector **100**. For example, in some cases, control signal may be associated with a battery within an electric vehicle. For example, control signal may include a battery sensor signal. As used in this disclosure, a "battery sensor signal" is a signal representative of a characteristic of a battery. In some cases, battery sensor signal may be representative of a characteristic of an electric vehicle battery, for example as electric vehicle battery is being recharged. In some versions, computing device **104** may additionally include a sensor interface configured to receive a battery sensor signal. Sensor interface may include one or more ports, an analog to digital converter, and the like. Computing device **104** may be further configured to control one or more of electrical charging current and coolant flow as a function of battery sensor signal and/or control signal. For example, computing device **104** may control coolant source and/or power source as a function of battery sensor signal and/or control signal. In some cases, battery sensor signal may be representative of battery temperature. In some cases, battery sensor signal may represent battery cell swell. In some cases, battery sensor signal may be representative of temperature of electric vehicle battery, for example temperature of one or more battery cells within an electric vehicle battery. In some cases, a sensor, a circuit, and/or a computing device **104** may perform one or more signal processing steps on a signal. For instance, sensor, circuit or controller **104** may analyze, modify, and/or synthesize a signal in order to improve the signal, for instance by improving transmission, storage efficiency, or signal to noise ratio.

Exemplary methods of signal processing may include analog, continuous time, discrete, digital, nonlinear, and statistical. Analog signal processing may be performed on non-digitized or analog signals. Exemplary analog processes may include passive filters, active filters, additive mixers, integrators, delay lines, compandors, multipliers, voltage-controlled filters, voltage-controlled oscillators, and phase-locked loops. Continuous-time signal processing may be used, in some cases, to process signals which varying continuously within a domain, for instance time. Exemplary non-limiting continuous time processes may include time domain processing, frequency domain processing (Fourier transform), and complex frequency domain processing. Discrete time signal processing may be used when a signal is sampled non-continuously or at discrete time intervals (i.e., quantized in time). Analog discrete-time signal processing may process a signal using the following exemplary circuits sample and hold circuits, analog time-division multiplexers, analog delay lines and analog feedback shift registers. Digital signal processing may be used to process digitized discrete-time sampled signals. Commonly, digital signal processing may be performed by a computing device or other specialized digital circuits, such as without limitation an application specific integrated circuit (ASIC), a field-programmable gate array (FPGA), or a specialized digital signal processor (DSP). Digital signal processing may be used to perform any combination of typical arithmetical operations, including fixed-point and floating-point, real-valued and complex-valued, multiplication and addition. Digital signal processing may additionally operate circular buffers and lookup tables. Further non-limiting examples of algorithms that may be performed according to digital signal processing techniques include fast Fourier transform (FFT), finite impulse response (FIR) filter, infinite impulse response (IIR) filter, and adaptive filters such as the Wiener and Kalman filters. Statistical signal processing may be used to process a signal as a random function (i.e., a stochastic process), utilizing statistical properties. For instance, in some embodiments, a signal may be modeled with a probability distribution indicating noise, which then may be used to reduce noise in a processed signal.

With continued reference to FIG. **1**, a conductor may include a ground conductor. As used in this disclosure, a "ground conductor" is a conductor configured to be in electrical communication with a ground. As used in this disclosure, a "ground" is a reference point in an electrical circuit, a common return path for electric current, or a direct physical connection to the earth. Ground may include an absolute ground such as earth or ground may include a relative (or reference) ground, for example in a floating configuration.

With continued reference to FIG. **1**, connector **100** may include a coolant flow path. Coolant flow path may have a distal end located substantially at connector **100**. As used in this disclosure, a "coolant flow path" is a component that is substantially impermeable to a coolant and contains and/or directs a coolant flow. As used in this disclosure, "coolant" may include any flowable heat transfer medium. Coolant may include a liquid, a gas, a solid, and/or a fluid. Coolant may include a compressible fluid and/or a non-compressible fluid. Coolant may include a non-electrically conductive liquid such as a fluorocarbon-based fluid, such as without limitation Fluorinert™ from 3M of Saint Paul, Minnesota, USA. In some cases, coolant may include air. As used in this disclosure, a "flow of coolant" is a stream of coolant. In some cases, coolant may include a fluid and coolant flow is a fluid flow. Alternatively or additionally, in some cases, coolant may include a solid (e.g., bulk material) and coolant flow may include motion of the solid. Exemplary forms of mechanical motion for bulk materials include fluidized flow, augers, conveyors, slumping, sliding, rolling, and the like. Coolant flow path may be in fluidic communication with a

coolant source **138**. As used in this disclosure, a "coolant source" is an origin, generator, reservoir, or flow producer of coolant. In some cases, a coolant source may include a flow producer, such as a fan and/or a pump. Coolant source may include any of following non-limiting examples, air conditioner, refrigerator, heat exchanger, pump, fan, expansion valve, and the like.

Still referring to FIG. **1**, in some embodiments, coolant source may be further configured to transfer heat between coolant, for example coolant belonging to coolant flow, and an ambient air. As used in this disclosure, "ambient air" is air which is proximal a system and/or subsystem, for instance the air in an environment which a system and/or sub-system is operating. For example, in some cases, coolant source comprises a heart transfer device between coolant and ambient air. Exemplary heat transfer devices include, without limitation, chillers, Peltier junctions, heat pumps, refrigeration, air conditioning, expansion or throttle valves, heat exchangers (air-to-air heat exchangers, air-to-liquid heat exchangers, shell-tube heat exchangers, and the like), vapor-compression cycle system, vapor absorption cycle system, gas cycle system, Stirling engine, reverse Carnot cycle system, and the like. In some versions, computing device **104** may be further configured to control a temperature of coolant. For instance, in some cases, a sensor may be located within thermal communication with coolant, such that sensor is able to detect, measure, or otherwise quantify temperature of coolant within a certain acceptable level of precision. In some cases, sensor may include a thermometer. Exemplary thermometers include without limitation, pyrometers, infrared non-contacting thermometers, thermistors, thermocouples, and the like. In some cases, thermometer may transduce coolant temperature to a coolant temperature signal and transmit the coolant temperature signal to computing device **104**. Computing device **104** may receive coolant temperature signal and control heat transfer between ambient air and coolant as a function of the coolant temperature signal. Computing device **104** may use any control method and/or algorithm used in this disclosure to control heat transfer, including without limitation proportional control, proportional-integral control, proportional-integral-derivative control, and the like. In some cases, controller **104** may be further configured to control temperature of coolant within a temperature range below an ambient air temperature. As used in this disclosure, an "ambient air temperature" is temperature of an ambient air. An exemplary non-limiting temperature range below ambient air temperature is about −5° C. to about −30° C. In some embodiments, coolant flow may substantially be comprised of air. In some cases, coolant flow may have a rate within a range a specified range. A non-limiting exemplary coolant flow range may be about 0.1 CFM and about 100 CFM.

With continued reference to FIG. **1**, computing device **104** may be configured to control one or more electrical charging current within conductor and coolant flow within coolant flow path. In some embodiments controller may control coolant source and/or power source according to a control signal. As used in this disclosure, "control signal" is any transmission from computing device **104** to a subsystem that may affect performance of subsystem. In some embodiments, control signal may be analog. In some cases, control signal may be digital. Control signal may be communicated according to one or more communication protocols, for example without limitation Ethernet, universal asynchronous receiver-transmitter, and the like. In some cases, control signal may be a serial signal. In some cases, control signal may be a parallel signal. Control signal may be communicated by way of a network, for example a controller area network (CAN). In some cases, control signal may include commands to operate one or more of coolant source and/or power source. For example, in some cases, coolant source may include a valve to control coolant flow and computing device **104** may be configured to control the valve by way of control signal. In some cases, coolant source may include a flow source (e.g., a pump, a fan, or the like) and computing device **104** may be configured to control the flow source by way of control signal. In some cases, coolant source may be configured to control a temperature of coolant and computing device **104** may be configured to control a coolant temperature setpoint or range by way of control signal. In some cases, power source may include one or electrical components configured to control flow of an electric recharging current or switches, relays, direct current to direct current (DC-DC) converters, and the like. In some case, power source may include one or more circuits configured to provide a variable current source to provide electric recharging current, for example an active current source. Non-limiting examples of active current sources include active current sources without negative feedback, such as current-stable nonlinear implementation circuits, following voltage implementation circuits, voltage compensation implementation circuits, and current compensation implementation circuits, and current sources with negative feedback, including simple transistor current sources, such as constant currant diodes, Zener diode current source circuits, LED current source circuits, transistor current, and the like, Op-amp current source circuits, voltage regulator circuits, and curpistor tubes, to name a few. In some cases, one or more circuits within power source or within communication with power source are configured to affect electrical recharging current according to control signal from computing device **104**, such that the computing device **104** may control at least a parameter of the electrical charging current. For example, in some cases, computing device **104** may control one or more of current (Amps), potential (Volts), and/or power (Watts) of electrical charging current by way of control signal. In some cases, computing device **104** may be configured to selectively engage electrical charging current, for example ON or OFF by way of control signal.

With continued reference to FIG. **1**, connector **100** may be configured such that one or more of a conductor and a coolant flow path make a connection with a mating component on within an electric vehicle port **112** when the connector **100** is mated with the electric vehicle port **112**. As used in this disclosure, a "mating component" is a component that is configured to mate with at least another component, for example in a certain (i.e., mated) configuration.

Still referring to FIG. **1**, system **100** includes at least a sensor **116**, where the at least a sensor is configured to detect an attachment, referred herein as attachment datum, of the housing **108** with an electric vehicle port **112**, and transmit the attachment datum to the computing device **104**. "Attachment datum" refers to data, or a signal, that confirms attachment. In an embodiment, attachment datum may include a signal confirming that connector **100** and electric vehicle port **112** are interlocked. In some embodiments, at least a sensor **116** may be a proximity sensor that generates a proximity signal and transmits the proximity signal to the computing device as a function of the attachment. In an embodiment, connector **100** may be coupled to a proximity signal conductor. As used in this disclosure, an "proximity signal conductor" is a conductor configured to carry a proximity signal. As used in this disclosure, a "proximity

signal" is a signal that is indicative of information about a location of connector. Proximity signal may be indicative of attachment of connector with a port, for instance electric vehicle port and/or test port. In some cases, a proximity signal may include an analog signal, a digital signal, an electrical signal, an optical signal, a fluidic signal, or the like. In embodiments, a proximity signal conductor may be configured to conduct a proximity signal indicative of attachment between connector **100** and an electric vehicle port **112**.

Continuing to refer to FIG. **1**, in an embodiment, computing device **104** may be configured to receive the proximity signal from the at least a sensor **116**. In some embodiments, at least a sensor **116** may include a proximity sensor. Proximity sensor may be electrically communicative with a proximity signal conductor. Proximity sensor may be configured to generate a proximity signal as a function of connection between connector **100** and an electric vehicle port **112**. As used in this disclosure, a "sensor" is a device that is configured to detect a phenomenon and transmit information related to the detection of the phenomenon. For example, in some cases a sensor may transduce a detected phenomenon, such as without limitation temperature, pressure, and the like, into a sensed signal. As used in this disclosure, a "proximity sensor" is a sensor that is configured to detect at least a phenomenon related to connecter being mated to a port. Proximity sensor may include any sensor described in this disclosure, including without limitation a switch, a capacitive sensor, a capacitive displacement sensor, a doppler effect sensor, an inductive sensor, a magnetic sensor, an optical sensor (such as without limitation a photoelectric sensor, a photocell, a laser rangefinder, a passive charge-coupled device, a passive thermal infrared sensor, and the like), a radar sensor, a reflection sensor, a sonar sensor, an ultrasonic sensor, fiber optics sensor, a Hall effect sensor, and the like.

Still referring to FIG. **1**, in some embodiments, connector **100** may include an isolation monitor conductor configured to conduct an isolation monitoring signal. In some cases, power systems for example power source or electric vehicle batteries must remain electrically isolated from communication, control, and/or sensor signals. As used in this disclosure, "isolation" is a state where substantially no communication of a certain type is possible between to components, for example electrical isolation refers to elements which are not in electrical communication. Often signal carrying conductors and components (e.g., sensors) may need to be in relatively close proximity with power systems and/or power carrying conductors. For instance, battery sensors which sense characteristics of batteries, for example batteries within an electric vehicle, are often by virtue of their function placed in close proximity with a battery. A battery sensor that measures battery charge and communicates a signal associated with battery charge back to controller **104** is at risk of becoming un-isolated from the battery. In some cases, an isolation monitoring signal will indicate isolation of one or more components. In some cases, an isolation monitoring signal may be generated by an isolation monitoring sensor. Isolation monitoring sensor may include any sensor described in this disclosure, such as without limitation a multi-meter, an impedance meter, and/or a continuity meter. In some cases, isolation from an electrical power (e.g., battery and/or power source) may be required for housing **108** and a ground. Isolation monitoring signal may, in some cases, communicate information about isolation between an electrical power and ground, for example along a flow path that includes connector **100**.

Still referring to FIG. **1**, in some embodiments, connector **100** may additionally include a coolant flow path being located proximal or otherwise in thermal communication with one or more conductors, for example direct current conductor and/or alternating current conductor. In some cases, heat generated within one or more conductors may be transferred into coolant within coolant flow path. In some cases, coolant flow path may be arranged substantially coaxial with one or more conductors, such that coolant flows substantially parallel with an axis of the one or more conductors. Alternatively or additionally, in some cases, coolant flow path may be arranged in cross flow with one or more conductors. In some cases, connector **100** may include a heat exchanged configured to extract heat from one or more conductors, for example at a location of high current and/or high impedance (e.g., resistance) within conductor. In some cases, generated heat within a conductor may be proportional to current within conductor squared. Heating within a conductor may be understood according to Joule heating, also referred to in this disclosure as resistive, resistance, or Ohmic heating. Joule-Lenz law states that power of heat generated by a conductor is proportional to a product of conductor resistance and a square of current within the conductor, see below.

$$P \propto I^2 R$$

where P is power of heat generated, for example in Watts, I is electric current within conductor, for example in Amps, and R is resistance of conductor, for example in Ohms. In some cases, coolant flow may be configured to provide a cooling load that is sufficient to cool at least a conductor and one or more electric vehicle batteries during charging.

Still referring to FIG. **1**, in some embodiments, one or more of at least a direct current conductor and at least an alternating current conductor may be further configured to conduct a communication signal and/or control signal by way of power line communication. In some cases, computing device **104** may be configured within communication of communication signal, for example by way of a power line communication modem. As used in this disclosure, "power line communication" is process of communicating at least a communication signal simultaneously with electrical power transmission. In some cases, power line communication may operate by adding a modulated carrier signal (e.g., communication signal) to a power conductor. Different types of power-line communications use different frequency bands. In some case, alternating current may have a frequency of about 50 or about 60 Hz. In some cases, power conductor may be shielded in order to prevent emissions of power line communication modulation frequencies. Alternatively or additionally, power line communication modulation frequency may be within a range unregulated by radio regulators, for example below about 500 KHz.

Still referring to FIG. **1**, in some embodiments, housing **108** may be configured to mate with a test port. For example, test port may be identical to electric vehicle port **112**. As used in this disclosure, a "test port" is port located outside of an electric vehicle that mates with connector. In some cases, test port may close a circuit with one or more conductors or flow paths within connector and thereby allow for said one more conductors or flow paths to be tested, for example for continuity, impedance, resistance, and the like. In some cases, test port may be configured to test functionality of one or more of the at least a direct current conductor, the at least an alternating current conductor, the at least a control signal conductor, the at least a ground conductor, the at least a coolant flow path, and the at least a proximity

conductor. Test port may facilitate one or more signals, for example feedback signals, to be communicated with computing device **104** as a function of connector **100** being attached with test port.

Still referring to FIG. **1**, computing device **104** is configured to receive the attachment datum from the at least a sensor **116**. Connection refers to establishing communication between entities consistent with "communication" described above.

Additionally, or alternatively, and still referring to FIG. **1**, connector **100** may be included in a charging pad. The charging pad may include a landing pad, where the landing pad may be any designated area for the electric airplane to land and/or takeoff. In one embodiment, the landing pad may be made of any suitable material and may be any dimension. In some embodiments, the landing pad may be a helideck or a helipad.

In some embodiments, and continuing to refer to FIG. **1**, the charging pad may include a charging component coupled to the landing pad, where the charging component may include any component with the capability of charging an energy source, such as a battery, of an electric aircraft. In one embodiment, the charging component may include a constant voltage charger, a constant current charger, a taper current charger, a pulser charger, a negative pulse charger, an IUI charger, a trickle charger, a float charger, a random charger, and the like.

In one embodiment, and still referring to FIG. **1**, charging pad may include a support component coupled to the bottom of the landing pad, where the support component may include any space dedicated for supporting the electric aircraft. In some embodiments, the support component may include an area dedicated to storage, a workshop for aircraft maintenance, an area dedicated to logistics, a pilot lounge, sleeping accommodations, a generator, and the like. In a nonlimiting example, the flight pad is a raised platform that is wide enough for an electric aircraft to land on it, furnished with a charging dock and with a compartment under the landing platform where the pilot may rest, or equipment related to electric vehicle charging may be stored.

Continuing to refer to FIG. **1**, computing device **104** is configured to receive an identification datum from the electric vehicle. In some embodiments, the computing device **104** may be configured to receive an encrypted identification datum. In embodiments, the computing device **104** may be configured to decrypt the identification datum. In some embodiments, the computing device **104** may be configured to utilize an authentication broker to decrypt the identification datum. "Identification datum", for the purpose of this disclosure, is described as any data used to identify an electric vehicle, such as an electric car, an electric motorcycle, an electric boat, an electric ship, an electric aircraft, an electric helicopter, an electric airplane, an eVTOL and the like. Identification datum may also be used to identify a user, such as a driver, a pilot, and the like. For example and without limitation identification datum may include a vehicle identification number (VIN), an aircraft registration, a user's pilot license information, a user's driver's license, fleet operator information, and the like. In an embodiment, the identification datum may be sent by a flight controller in the aircraft. In some embodiments the identification datum may be sent by the at least a sensor **116**.

Still referring to FIG. **1**, computing device **104** is configured to generate a verification datum as a function of the identification datum and the attachment datum, where generating the verification datum includes comparing the identification datum against a data store system. "Data store system", for the purpose of this disclosure, refers to any system configured to store data, such as a database. Data store system **120** may be implemented, without limitation, as a relational database, a key-value retrieval datastore such as a NOSQL database, or any other format or structure for use as a datastore that a person skilled in the art would recognize as suitable upon review of the entirety of this disclosure. Computing device **104** may include any suitable software and/or hardware as described in the entirety of this disclosure. In an embodiment, computing device **104** is configured to authenticate the connection. Computing device **104** may be configured to receive a credential associated with a user and/or vehicle as a function of the connection, compare the credential from user and/or vehicle to an authorized credential stored within an authentication database, and bypass authentication for user and/or vehicle based on the comparison of the credential from user and/or vehicle to the authorized credential stored within the authentication database. A "credential" as described in the entirety of this disclosure, is a datum representing an identity, attribute, code, and/or characteristic specific to a user and/or vehicle. For example and without limitation, the credential may include a username and password unique to the user and/or user device. The username and password may include any alpha-numeric character, letter case, and/or special character. As a further example and without limitation, the credential may include a digital certificate, such as a PKI certificate. Authentication may include an additional computing device, such as a mobile device, laptop, desktop computer, or the like. In a non-limiting example, the additional computing device may be a computer and/or smart phone operated by a fleet operator remotely.

Still referring to FIG. **1**. In an embodiment, generating a verification datum may include utilizing an SSL/TLS handshake protocol. In an embodiment, the identification datum includes a public key from a public-private key pair generated by a controller in an electric aircraft. In an embodiment, the data store system may be a remote server. In some embodiments, the data store system may be a Certificate Authority. In a nonlimiting example, computing device sends the identification datum to a Certificate Authority, the Certificate Authority then creates a digital certificate with the electric aircraft and/or the user's public key and certificate attributes verifying the identification datum, and signs the certificate with the electric aircraft and/or user's private key. In one embodiment, the data store system is a charging pad. In an embodiment, computing device **104** is configured to function as an intermediate certificate authority. In a nonlimiting example, the charging pad may function as an intermediate certificate authority, where the client is assigned and authenticated against an intermediate certificate, which allows computing device **104** to authenticate the connection even when offline. In nonlimiting examples, charging pad may be a smart charger, a Vehicle-to-Grid (V2G) charger, and the like. In some embodiments, computing device **104** may further include utilizing an authentication terminal, such as an RFID reader to generate a verification datum. In some embodiments, generating the verification datum may further include utilizing a two-step authentication, such as utilizing an RSA key. In embodiments, system **100** may utilize any type of cryptographic protocol. In an embodiment, data store system **120** may be further configured to include a public vulnerability database. In an embodiment, computing device **104** may be further configured to check the vulnerability database before establishing a connection. In a nonlimiting example, the user plugs a charging connector to the electric aircraft, proximity

sensors coupled to the electric aircraft and charging component may generate a signal to establish a connection, the computing device **104** may then query the vulnerability database before choosing a cryptographic protocol to use for the connection, once a cryptographic protocol is chosen, the encrypted identification datum pertaining to the electric aircraft and/or user is then verified against a data store system **120**, such as a certificate authority. "Verification datum", for the purpose of this disclosure, may refer to data verifying the unique identity of the electric aircraft and/or user's unique identity. Verification datum may include a certificate, issued by a certificate authority, signed with the electric aircraft and/or user's private-key, a security token issued by an authentication broker, a key from a 2-step authentication method, an RFID tag, and the like. In some embodiments, verification datum may be a voltage threshold. In a nonlimiting example, the computing device may generate a specific voltage after performing the verification, where the computing device may generate a voltage lower than the voltage threshold when verification is unsuccessful and a voltage higher than the voltage threshold when verification is successful.

Additionally, or alternatively, computing device **104** may be configured to utilize any front-end protocol for connecting the electric aircraft to the charging component. Nonlimiting examples of front-end protocols may include CHAdeMO, ISO-15118, ISO-15118-20, IEC61851-1, and the like. In embodiments, computing device **104** may be configured to use any back-end protocol for comparing the identification datum against a data store system. Nonlimiting examples of back-end protocols may include OCPP, IEC63110, OpenADR, EEBus, IEEE2030.5, and the like.

Continuing to refer to FIG. **1**, computing device **104** is configured to determine an authorization status as a function of the verification datum. "Authorization status" for the purpose of this disclosure, refers to data containing a status related to the authorization, such as data signal containing a binary authorization status attribute. In a nonlimiting example, a charging component may only start charging the electric aircraft once the computing device **104** determines the authorization status to be authorized for charging. In some embodiments, the computing device **104** may also trigger a lock mechanism as a function of the authorization status. In a nonlimiting example, the charging component may mechanically lock the charging station and the electric aircraft charging dock for the duration of the transaction. In some embodiments, the authorization status may be changed through a remote connection. In a nonlimiting example, a user, through the interaction with a device such as a smartphone, may choose to end the transaction. In some embodiments, the authorization status may be changed as a function of the passage of time. In other embodiments, the authorization status may be changed as function of the battery level. In a nonlimiting example, the computing device **104** may determine as new authorization status, after initial connection had been established, due to the battery charge of an electric aircraft being full. In an embodiment, the computing device **104** may determine a new authorization status, after initial connection had been established, as a function of a user's billing information. In a nonlimiting example, the computing device **104** may be configured to revoke the authorized status once a user's fund is depleted, and the connection may only be re-authorized once the user adds more funds. In an embodiment, user's billing information may be in a blockchain network. In some embodiments, user's billing information may include a crypto-currency. Nonlimiting examples of crypto-currencies may include Bitcoin, Etherum, and the like.

Additionally, or alternatively, generating the verification datum may further include selecting a correlated dataset containing a plurality of data entries wherein each dataset contains at least a datum of identification data and at least a first correlated authentication datum; and generating, at a clustering unsupervised machine-learning model, a verification datum as a function of the attachment data, the identification data and the correlated dataset. "Authentication datum" as used herein includes any data suitable for use in authenticating a user and/or device. Dataset may be selected and contained within the data store system **120**. Dataset may be stored in any suitable data and/or data type. For instance, and without limitation, dataset may include textual data, such as numerical, character, and/or string data. "Clustering" refers to the process of grouping similar entities, or elements, together. "Unsupervised machine-learning model", for the purpose of this disclosure, refers to machine learning algorithms that analyze and cluster unlabeled datasets without requiring human intervention.

Referring now to FIG. **2**, an exemplary flow diagram of a method **200** for authorizing battery charging in an electric vehicle is illustrated. At step **205**, method **200** includes detecting, at an least a sensor **116**, an attachment datum as a function of the housing **108** mating with the electric vehicle port **112**. In a nonlimiting example, a proximity signal is generated by sensor **116** once connector **100** is attached to electric vehicle port **112** which detects the connection with the electric vehicle port **112**. In an embodiment, method further includes detecting attachment datum as a function of an interlocking mechanism.

Still referring to FIG. **2**, at step **210**, method **200** includes transmitting, by at least a sensor **116**, the attachment datum to a computing device **104**. In a nonlimiting example, at least a sensor **116** may transmit information to the computing device **104** signaling that connector **100** is attached to the electric vehicle port **112** and authentication can start.

Still referring to FIG. **2**, at step **215**, method **200** includes receiving, at a computing device **104**, the attachment datum from the at least a sensor **116**. In an nonlimiting example, computing device **104** may receive a proximity signal from a proximity sensor.

Continuing to refer to FIG. **2**, at step **220**, method **200** includes receiving, at the computing device **104**, an identification datum from the electric vehicle. In an embodiment, method **200** may include storing, by the computing device **104**, the identification datum in a data store system **120**. In a nonlimiting example, computing device **104** receives data identifying the electric vehicle attached to connector **100**. In a nonlimiting example, data store system **120** may be a remote database, where identification datum may be stored.

Still referring to FIG. **2**, at step **225**, method **200** includes generating, by the computing device **104**, a verification datum as a function of the identification datum and the attachment datum. In a nonlimiting example, computing device **104** authenticates the electric vehicle and user against a Certificate Authority, and once they are successfully authenticated, the computing device **104** generates a voltage signal that is higher than a set threshold. In an embodiments, Certificate authority is a data store system **120**. In another nonlimiting example, once authentication fails, computing device **104** generates a voltage that is below a set threshold. Certificate authority in some embodiments contains data conveying the certificate authority's authorization for the recipient to perform a task. The authorization may be the authorization to access a given datum. The authorization

may be the authorization to access a given process. In some embodiments, the certificate may identify the certificate authority. The digital certificate may include a digital signature.

Continuing to refer to FIG. **2**, at step **230**, method **200** includes determining, by the computing device **104**, an authorization status as a function of the verification datum. In an embodiment, transmitting, by the computing device **104**, the authorization status to a user device. In embodiments, method **200** may include storing, by the computing device **104**, the authorization status in a data store system **120**. In a nonlimiting example, computing device **104** may compare the voltage generated to the set threshold, if the voltage is lower than threshold, the computing device **104** generates an OFF status, which prevents the flow of energy to the electric vehicle attached to the connector **100**. In another nonlimiting example, computing device **104** may compare the voltage generated to the set threshold, if the voltage is higher than the set threshold, computing device generates an ON status, which starts the charging process.

Additionally, or alternatively, generating the verification datum further includes selecting a correlated dataset containing a plurality of data entries wherein each dataset contains at least a datum of identification data and at least a first correlated authentication datum, and generating, at a clustering unsupervised machine-learning model **124**, a verification datum as a function of the attachment data, the identification data and the correlated dataset.

Referring now to FIG. **3**, an exemplary connector **100** is schematically illustrated. Connector **100** is illustrated with a tether **304**. Tether **304** may include one or more conductors and/or coolant flow paths. Tether **304** may include a conduit, for instance a jacket, enshrouding one or more conductors and/or coolant flow paths. In some cases. conduit may be flexible, electrically insulating, and/or fluidically sealed. As shown in FIG. **3**, exemplary connector **100** is shown with a first power conductor and a second power conductor. As used in this disclosure, a "power conductor" is a conductor configured to conduct an electrical charging current, for example a direct current and/or an alternating current. In some cases, a conductor may include a cable and a contact. A cable may include any electrically conductive cable including without limitation cables containing copper and/or copper alloys. As used in this disclosure, a "contact" is an electrically conductive component that is configured to make physical contact with a mating electrically conductive component, thereby facilitating electrical communication between the contact and the mating component. In some cases, a contact may be configured to provide electrical communication with a mating component within a port. In some cases, a contact may contain copper and/or copper-alloy. In some cases, contact may include a coating. A contact coating may include without limitation hard gold, hard gold flashed palladium-nickel (e.g., 80/30), tin, silver, diamond-like carbon, and the like.

With continued reference to FIG. **3**, a first conductor may include a first cable **308***a* and a first contact **312***a* in electrical communication with the first cable. Likewise, a second conductor may include a second cable **308***b* and a second contact **312***b* in electrical communication with the second cable. In an embodiment, first cable **308***a* and second cable **308***b* are nested inside a housing **108**. In an embodiment, first contact **312***a* and second contact **312***b* includes at least a sensor **116**. In an embodiment, the first conductor and second conductor are nested inside a housing **108**. In embodiments, first cable **308***a* and second cable **308***b* may be configured to transmit the attachment datum. In embodiments, first cable **308***a* and second cable **308***b* may be configured to transmit the identification datum from the electric vehicle.

Still referring to FIG. **3**, connector **100** may include an interlock **316** mechanism. "Interlock mechanism" refers to a mechanism that mechanically locks a connector **100** to the electric vehicle port **112**. In an embodiment, interlock **316** may lock the connector to the vehicle port **112** while authentication is being performed. In some embodiments, attachment datum may only be transmitted when interlock **316** is engaged. In a nonlimiting example, connector may disengage the interlock **316** if authentication is not successful.

Referring now to FIG. **4**, an exemplary cross-sectional view of an exemplary connector **400** is illustrated. Connector **100** is illustrated with a tether **404**. Tether **404** may include one or more conductors and/or coolant flow paths. Connector **400** is shown with a first power conductor and a second power conductor. A first conductor may include a first cable **408***a* and a first contact **412***a* in electrical communication with the first cable. Likewise, a second conductor may include a second cable **408***b* and a second contact **412***b* in electrical communication with the second cable. In an embodiment, first cable **408***a* and second cable **408***b* may be contained inside a housing **108**. In other embodiments, first contact **413***a* and second contact **413***b* may be protected by a housing **108**.

Still referring to FIG. **4**, connector **100** is shown with an interlock **416** mechanism. Interlock **416** mechanism may be configured for used with a plurality of types of connectors including GB/T stander, CSS type 1, commonly used in North America, CSS type 2, commonly used in Europe, CHAdeMO, and the like. In embodiments, attachment datum may be detected as a function of the interlocking mechanism. In embodiments, interlocking mechanism may include at least a sensor **116**.

As shown in FIG. **4**, in some cases, connector **100** may include a fitting. In some cases, fitting may include one or more seals **420**. Seals may include any seal described in this disclosure and may be configured to seal a joint between a housing **108** and a mating component (e.g., fitting and/or additionally coolant flow path) within port, when connector is attached to the port. As used in this disclosure, a "seal" is a component that is substantially impermeable to a substance (e.g., coolant, air, and/or water) and is designed and/or configured to prevent flow of that substance at a certain location, e.g., joint. Seal may be configured to seal coolant. In some cases, seal may include at least one of a gasket, an O-ring, a mechanical fit (e.g., press fit or interference fit), and the like. In some cases, seal may include an elastomeric material, for example without limitation silicone, buna-N, fluoroelastomer, fluorosilicone, polytetrafluoroethylene, polyethylene, polyurethane, rubber, ethylene propylene diene monomer, and the like. In some cases, seal may include a compliant element, such as without limitation a spring or elastomeric material, to ensure positive contact of seal with a sealing face. In some cases, seal may include a piston seal and/or a face seal. As used in this disclosure, a "joint" is a transition region between two components.

With continued reference to FIG. **4**, in some embodiments, connector may include a valve **424**. Valve **424** may include any type of valve, for example a mechanical valve, an electrical valve, a check valve, or the like. In some cases, valve **434** may include quick disconnect. In some cases, valve **424** may include a normally-closed vale, for example a mushroom-poppet style valve, as shown in FIG. **4**. Additional non-limiting examples of normally-closed valves

include solenoid valves, a spring-loaded valve, and the like. In some cases, a valve may include one or more of a ball valve, a butterfly valve, a body valve, a bonnet valve, a port valve, an actuator valve, a disc valve, a seat valve, a stem valve, a gasket valve, a trim valve, or the like. In some cases, valve **424** may be configured to open when connector is attached to port and/or is mated with a mating component within port. In some cases, valve **424** may be automatically opened/closed, for example by a controller. As described in more detail below, in some exemplary embodiments, mating of certain components within connector and port occur in prescribed sequence. In some cases, valve **424** may be configured not to open until after connection of one or more conductors **412***a-b*.

Referring now to FIG. **5**, an embodiment of an electric aircraft **500** is presented. Still referring to FIG. **5**, electric aircraft **500** may include a vertical takeoff and landing aircraft (eVTOL). As used herein, a vertical take-off and landing (eVTOL) aircraft is one that can hover, take off, and land vertically. An eVTOL, as used herein, is an electrically powered aircraft typically using an energy source, of a plurality of energy sources to power the aircraft. In order to optimize the power and energy necessary to propel the aircraft. eVTOL may be capable of rotor-based cruising flight, rotor-based takeoff, rotor-based landing, fixed-wing cruising flight, airplane-style takeoff, airplane-style landing, and/or any combination thereof. Rotor-based flight, as described herein, is where the aircraft generated lift and propulsion by way of one or more powered rotors coupled with an engine, such as a "quad copter," multi-rotor helicopter, or other vehicle that maintains its lift primarily using downward thrusting propulsors. Fixed-wing flight, as described herein, is where the aircraft is capable of flight using wings and/or foils that generate life caused by the aircraft's forward airspeed and the shape of the wings and/or foils, such as airplane-style flight.

With continued reference to FIG. **5**, a number of aerodynamic forces may act upon the electric aircraft **500** during flight. Forces acting on an electric aircraft **500** during flight may include, without limitation, thrust, the forward force produced by the rotating element of the electric aircraft **500** and acts parallel to the longitudinal axis. Another force acting upon electric aircraft **500** may be, without limitation, drag, which may be defined as a rearward retarding force which is caused by disruption of airflow by any protruding surface of the electric aircraft **500** such as, without limitation, the wing, rotor, and fuselage. Drag may oppose thrust and acts rearward parallel to the relative wind. A further force acting upon electric aircraft **500** may include, without limitation, weight, which may include a combined load of the electric aircraft **500** itself, crew, baggage, and/or fuel. Weight may pull electric aircraft **500** downward due to the force of gravity. An additional force acting on electric aircraft **500** may include, without limitation, lift, which may act to oppose the downward force of weight and may be produced by the dynamic effect of air acting on the airfoil and/or downward thrust from the propulsor of the electric aircraft. Lift generated by the airfoil may depend on speed of airflow, density of air, total area of an airfoil and/or segment thereof, and/or an angle of attack between air and the airfoil. For example, and without limitation, electric aircraft **500** are designed to be as lightweight as possible. Reducing the weight of the aircraft and designing to reduce the number of components is essential to optimize the weight. To save energy, it may be useful to reduce weight of components of an electric aircraft **500**, including without limitation propulsors and/or propulsion assemblies. In an embodiment, the motor may eliminate need for many external structural features that otherwise might be needed to join one component to another component. The motor may also increase energy efficiency by enabling a lower physical propulsor profile, reducing drag and/or wind resistance. This may also increase durability by lessening the extent to which drag and/or wind resistance add to forces acting on electric aircraft **500** and/or propulsors.

Still referring to FIG. **5**. In an embodiment, electric aircraft **500** may include a battery pack **504**. Battery pack **504** is a power source that may be configured to store electrical energy in the form of a plurality of battery modules, which themselves include of a plurality of electrochemical cells. These cells may utilize electrochemical cells, galvanic cells, electrolytic cells, fuel cells, flow cells, and/or voltaic cells. In general, an electrochemical cell is a device capable of generating electrical energy from chemical reactions or using electrical energy to cause chemical reactions, this disclosure will focus on the former. Voltaic or galvanic cells are electrochemical cells that generate electric current from chemical reactions, while electrolytic cells generate chemical reactions via electrolysis. In general, the term 'battery' is used as a collection of cells connected in series or parallel to each other. A battery cell may, when used in conjunction with other cells, may be electrically connected in series, in parallel or a combination of series and parallel. Series connection includes wiring a first terminal of a first cell to a second terminal of a second cell and further configured to include a single conductive path for electricity to flow while maintaining the same current (measured in Amperes) through any component in the circuit. A battery cell may use the term 'wired', but one of ordinary skill in the art would appreciate that this term is synonymous with 'electrically connected', and that there are many ways to couple electrical elements like battery cells together. An example of a connector that does not include wires may be prefabricated terminals of a first gender that mate with a second terminal with a second gender. Battery cells may be wired in parallel. Parallel connection includes wiring a first and second terminal of a first battery cell to a first and second terminal of a second battery cell and further configured to include more than one conductive path for electricity to flow while maintaining the same voltage (measured in Volts) across any component in the circuit. Battery cells may be wired in a series-parallel circuit which combines characteristics of the constituent circuit types to this combination circuit. Battery cells may be electrically connected in a virtually unlimited arrangement which may confer onto the system the electrical advantages associated with that arrangement such as high-voltage applications, high-current applications, or the like. In an exemplary embodiment, battery pack **504** may include 196 battery cells in series and 18 battery cells in parallel. This is, as someone of ordinary skill in the art would appreciate, is only an example and battery pack may be configured to have a near limitless arrangement of battery cell configurations.

Still referring to FIG. **5**. In an embodiment, battery pack **504** may include a plurality of battery modules. The battery modules may be wired together in series and in parallel. Battery pack **504** may include a center sheet which may include a thin barrier. The barrier may include a fuse connecting battery modules on either side of the center sheet. The fuse may be disposed in or on the center sheet and configured to connect to an electric circuit comprising a first battery module and therefore battery unit and cells. In general, and for the purposes of this disclosure, a fuse is an electrical safety device that operate to provide overcurrent

protection of an electrical circuit. As a sacrificial device, its essential component is metal wire or strip that melts when too much current flows through it, thereby interrupting energy flow. The fuse may include a thermal fuse, mechanical fuse, blade fuse, expulsion fuse, spark gap surge arrestor, varistor, or a combination thereof.

Continuing to refer to FIG. **5**, in an embodiment, battery pack **504** may also include a side wall includes a laminate of a plurality of layers configured to thermally insulate the plurality of battery modules from external components of battery pack **504**. The side wall layers may include materials which possess characteristics suitable for thermal insulation as described in the entirety of this disclosure like fiberglass, air, iron fibers, polystyrene foam, and thin plastic films, to name a few. The side wall may additionally or alternatively electrically insulate the plurality of battery modules from external components of battery pack **504** and the layers of which may include polyvinyl chloride (PVC), glass, asbestos, rigid laminate, varnish, resin, paper, Teflon, rubber, and mechanical lamina. The center sheet may be mechanically coupled to the side wall in any manner described in the entirety of this disclosure or otherwise undisclosed methods, alone or in combination. The side wall may include a feature for alignment and coupling to the center sheet. This feature may include a cutout, slots, holes, bosses, ridges, channels, and/or other undisclosed mechanical features, alone or in combination.

In a further embodiment, battery pack may also include an end panel including a plurality of electrical connectors and further configured to fix battery pack **504** in alignment with at least the side wall. The end panel may include a plurality of electrical connectors of a first gender configured to electrically and mechanically couple to electrical connectors of a second gender. The end panel may be configured to convey electrical energy from battery cells to at least a portion of an electric aircraft **500**. Electrical energy may be configured to power at least a portion of an electric aircraft **500** or include signals to notify aircraft computers, personnel, users, pilots, and any others of information regarding battery health, emergencies, and/or electrical characteristics. The plurality of electrical connectors may include blind mate connectors, plug and socket connectors, screw terminals, ring and spade connectors, blade connectors, and/or an undisclosed type alone or in combination. The electrical connectors of which the end panel includes may be configured for power and communication purposes. A first end of the end panel may be configured to mechanically couple to a first end of a first side wall by a snap attachment mechanism, similar to end cap and side panel configuration utilized in the battery module. To reiterate, a protrusion disposed in or on the end panel may be captured, at least in part, by a receptacle disposed in or on the side wall. A second end of end the panel may be mechanically coupled to a second end of a second side wall in a similar or the same mechanism.

Still referring to FIG. **5**. At least a sensor **116** may be disposed in or on a portion of battery pack **504** near battery modules or battery cells. Battery pack **504** includes battery management system head unit disposed on a first end of battery pack. Battery management system head unit is configured to communicate with a flight controller using a controller area network (CAN). Controller area network includes bus. Bus may include an electrical bus. "Bus", for the purposes of this disclosure and in electrical parlance is any common connection to which any number of loads, which may be connected in parallel, and share a relatively similar voltage may be electrically coupled. Bus may refer to power busses, audio busses, video busses, computing address busses, and/or data busses. Bus may be responsible for conveying electrical energy stored in battery pack to at least a portion of an electric aircraft. Bus may be additionally or alternatively responsible for conveying electrical signals generated by any number of components within battery pack to any destination on or offboard an electric aircraft. Bus may additionally be responsible for conveying electric signals generated by a charging component of a charging pad to the battery pack **504**. Battery management system head unit may comprise wiring or conductive surfaces only in portions required to electrically couple bus to electrical power or necessary circuits to convey that power or signals to their destinations.

Continuing to refer to FIG. **5**. Outputs from sensors **116** or any other component present within system may be analog or digital. Onboard or remotely located processors can convert those output signals from at least a sensor **116** to a usable form by the destination of those signals. The usable form of output signals from sensors, through processor may be either digital, analog, a combination thereof or an otherwise unstated form. Processing may be configured to trim, offset, or otherwise compensate the outputs of at least a sensor **116**. Based on sensor output, the processor can determine the output to send to downstream component. Processor can include signal amplification, operational amplifier (OpAmp), filter, digital/analog conversion, linearization circuit, current-voltage change circuits, resistance change circuits such as Wheatstone Bridge, an error compensator circuit, a combination thereof or otherwise undisclosed components.

With continued reference to FIG. **5**. Any of the disclosed components or systems, namely battery pack **504**, and/or battery cells may incorporate provisions to dissipate heat energy present due to electrical resistance in integral circuit. Battery pack **504** includes one or more battery element modules wired in series and/or parallel. The presence of a voltage difference and associated amperage inevitably will increase heat energy present in and around battery pack as a whole. The presence of heat energy in a power system is potentially dangerous by introducing energy possibly sufficient to damage mechanical, electrical, and/or other systems present in at least a portion of an electric aircraft **500**. Battery pack **504** may include mechanical design elements, one of ordinary skill in the art, may thermodynamically dissipate heat energy away from battery pack **504**. The mechanical design may include, but is not limited to, slots, fins, heat sinks, perforations, a combination thereof, or another undisclosed element.

Still referring to FIG. **5**. Heat dissipation may include material selection beneficial to move heat energy in a suitable manner for operation of battery pack **504**. Certain materials with specific atomic structures and therefore specific elemental or alloyed properties and characteristics may be selected in construction of battery pack to transfer heat energy out of a vulnerable location or selected to withstand certain levels of heat energy output that may potentially damage an otherwise unprotected component. One of ordinary skill in the art, after reading the entirety of this disclosure would understand that material selection may include titanium, steel alloys, nickel, copper, nickel-copper alloys such as Monel, tantalum and tantalum alloys, tungsten and tungsten alloys such as Inconel, a combination thereof, or another undisclosed material or combination thereof. Heat dissipation may include a combination of mechanical design and material selection. The responsibility of heat dissipation may fall upon the material selection and design as disclosed above in regard to any component disclosed in

this paper. The battery pack **504** may include similar or identical features and materials ascribed to battery pack in order to manage the heat energy produced by these systems and components. In an embodiments, the circuitry disposed within or on battery pack **504** may be shielded from electromagnetic interference. The battery elements and associated circuitry may be shielded by material such as mylar, aluminum, copper a combination thereof, or another suitable material. The battery pack and associated circuitry may include one or more of the aforementioned materials in their inherent construction or additionally added after manufacture for the express purpose of shielding a vulnerable component. The battery pack **504** and associated circuitry may alternatively or additionally be shielded by location. Electrochemical interference shielding by location includes a design configured to separate a potentially vulnerable component from energy that may compromise the function of said component. The location of vulnerable component may be a physical uninterrupted distance away from an interfering energy source, or location configured to include a shielding element between energy source and target component. The shielding may include an aforementioned material in this section, a mechanical design configured to dissipate the interfering energy, and/or a combination thereof. The shielding comprising material, location and additional shielding elements may defend a vulnerable component from one or more types of energy at a single time and instance or include separate shielding for individual potentially interfering energies.

Now referring to FIG. **6**, an exemplary embodiment **600** of a flight controller **604** is illustrated. As used in this disclosure a "flight controller" is a computing device of a plurality of computing devices dedicated to data storage, security, distribution of traffic for load balancing, and flight instruction. Flight controller **604** may include and/or communicate with any computing device as described in this disclosure, including without limitation a microcontroller, microprocessor, digital signal processor (DSP) and/or system on a chip (SoC) as described in this disclosure. Further, flight controller **604** may include a single computing device operating independently, or may include two or more computing device operating in concert, in parallel, sequentially or the like; two or more computing devices may be included together in a single computing device or in two or more computing devices. In embodiments, flight controller **604** may be installed in an aircraft, may control the aircraft remotely, and/or may include an element installed in the aircraft and a remote element in communication therewith.

In an embodiment, and still referring to FIG. **6**, flight controller **604** may include a signal transformation component **608**. As used in this disclosure a "signal transformation component" is a component that transforms and/or converts a first signal to a second signal, wherein a signal may include one or more digital and/or analog signals. For example, and without limitation, signal transformation component **608** may be configured to perform one or more operations such as preprocessing, lexical analysis, parsing, semantic analysis, and the like thereof. In an embodiment, and without limitation, signal transformation component **608** may include one or more analog-to-digital convertors that transform a first signal of an analog signal to a second signal of a digital signal. For example, and without limitation, an analog-to-digital converter may convert an analog input signal to a 10-bit binary digital representation of that signal. In another embodiment, signal transformation component **608** may include transforming one or more low-level languages such as, but not limited to, machine languages and/or assembly languages. For example, and without limitation, signal transformation component **608** may include transforming a binary language signal to an assembly language signal. In an embodiment, and without limitation, signal transformation component **608** may include transforming one or more high-level languages and/or formal languages such as but not limited to alphabets, strings, and/or languages. For example, and without limitation, high-level languages may include one or more system languages, scripting languages, domain-specific languages, visual languages, esoteric languages, and the like thereof. As a further non-limiting example, high-level languages may include one or more algebraic formula languages, business data languages, string and list languages, object-oriented languages, and the like thereof.

Still referring to FIG. **6**, signal transformation component **608** may be configured to optimize an intermediate representation **612**. As used in this disclosure an "intermediate representation" is a data structure and/or code that represents the input signal. Signal transformation component **608** may optimize intermediate representation as a function of a data-flow analysis, dependence analysis, alias analysis, pointer analysis, escape analysis, and the like thereof. In an embodiment, and without limitation, signal transformation component **608** may optimize intermediate representation **612** as a function of one or more inline expansions, dead code eliminations, constant propagation, loop transformations, and/or automatic parallelization functions. In another embodiment, signal transformation component **608** may optimize intermediate representation as a function of a machine dependent optimization such as a peephole optimization, wherein a peephole optimization may rewrite short sequences of code into more efficient sequences of code. Signal transformation component **608** may optimize intermediate representation to generate an output language, wherein an "output language," as used herein, is the native machine language of flight controller **604**. For example, and without limitation, native machine language may include one or more binary and/or numerical languages.

In an embodiment, and without limitation, signal transformation component **608** may include transform one or more inputs and outputs as a function of an error correction code. An error correction code, also known as error correcting code (ECC), is an encoding of a message or lot of data using redundant information, permitting recovery of corrupted data. An ECC may include a block code, in which information is encoded on fixed-size packets and/or blocks of data elements such as symbols of predetermined size, bits, or the like. Reed-Solomon coding, in which message symbols within a symbol set having q symbols are encoded as coefficients of a polynomial of degree less than or equal to a natural number k, over a finite field F with q elements; strings so encoded have a minimum hamming distance of k+1, and permit correction of (q−k−1)/2 erroneous symbols. Block code may alternatively or additionally be implemented using Golay coding, also known as binary Golay coding, Bose-Chaudhuri, Hocquenghuem (BCH) coding, multidimensional parity-check coding, and/or Hamming codes. An ECC may alternatively or additionally be based on a convolutional code.

In an embodiment, and still referring to FIG. **6**, flight controller **604** may include a reconfigurable hardware platform **616**. A "reconfigurable hardware platform," as used herein, is a component and/or unit of hardware that may be reprogrammed, such that, for instance, a data path between elements such as logic gates or other digital circuit elements may be modified to change an algorithm, state, logical

sequence, or the like of the component and/or unit. This may be accomplished with such flexible high-speed computing fabrics as field-programmable gate arrays (FPGAs), which may include a grid of interconnected logic gates, connections between which may be severed and/or restored to program in modified logic. Reconfigurable hardware platform **616** may be reconfigured to enact any algorithm and/or algorithm selection process received from another computing device and/or created using machine-learning processes.

Still referring to FIG. **6**, reconfigurable hardware platform **616** may include a logic component **620**. As used in this disclosure a "logic component" is a component that executes instructions on output language. For example, and without limitation, logic component may perform basic arithmetic, logic, controlling, input/output operations, and the like thereof. Logic component **620** may include any suitable processor, such as without limitation a component incorporating logical circuitry for performing arithmetic and logical operations, such as an arithmetic and logic unit (ALU), which may be regulated with a state machine and directed by operational inputs from memory and/or sensors; logic component **620** may be organized according to Von Neumann and/or Harvard architecture as a non-limiting example. Logic component **620** may include, incorporate, and/or be incorporated in, without limitation, a microcontroller, microprocessor, digital signal processor (DSP), Field Programmable Gate Array (FPGA), Complex Programmable Logic Device (CPLD), Graphical Processing Unit (GPU), general purpose GPU, Tensor Processing Unit (TPU), analog or mixed signal processor, Trusted Platform Module (TPM), a floating point unit (FPU), and/or system on a chip (SoC). In an embodiment, logic component **620** may include one or more integrated circuit microprocessors, which may contain one or more central processing units, central processors, and/or main processors, on a single metal-oxide-semiconductor chip. Logic component **620** may be configured to execute a sequence of stored instructions to be performed on the output language and/or intermediate representation **612**. Logic component **620** may be configured to fetch and/or retrieve the instruction from a memory cache, wherein a "memory cache," as used in this disclosure, is a stored instruction set on flight controller **604**. Logic component **620** may be configured to decode the instruction retrieved from the memory cache to opcodes and/or operands. Logic component **620** may be configured to execute the instruction on intermediate representation **612** and/or output language. For example, and without limitation, logic component **620** may be configured to execute an addition operation on intermediate representation **612** and/or output language.

In an embodiment, and without limitation, logic component **620** may be configured to calculate a flight element **624**. As used in this disclosure a "flight element" is an element of datum denoting a relative status of aircraft. For example, and without limitation, flight element **624** may denote one or more torques, thrusts, airspeed velocities, forces, altitudes, groundspeed velocities, directions during flight, directions facing, forces, orientations, and the like thereof. For example, and without limitation, flight element **624** may denote that aircraft is cruising at an altitude and/or with a sufficient magnitude of forward thrust. As a further non-limiting example, flight status may denote that is building thrust and/or groundspeed velocity in preparation for a takeoff. As a further non-limiting example, flight element **624** may denote that aircraft is following a flight path accurately and/or sufficiently.

Still referring to FIG. **6**, flight controller **604** may include a chipset component **628**. As used in this disclosure a "chipset component" is a component that manages data flow. In an embodiment, and without limitation, chipset component **628** may include a northbridge data flow path, wherein the northbridge dataflow path may manage data flow from logic component **620** to a high-speed device and/or component, such as a RAM, graphics controller, and the like thereof. In another embodiment, and without limitation, chipset component **628** may include a southbridge data flow path, wherein the southbridge dataflow path may manage data flow from logic component **620** to lower-speed peripheral buses, such as a peripheral component interconnect (PCI), industry standard architecture (ICA), and the like thereof. In an embodiment, and without limitation, southbridge data flow path may include managing data flow between peripheral connections such as ethernet, USB, audio devices, and the like thereof. Additionally or alternatively, chipset component **628** may manage data flow between logic component **620**, memory cache, and a flight component **632**. As used in this disclosure a "flight component" is a portion of an aircraft that can be moved or adjusted to affect one or more flight elements. For example, flight component **632** may include a component used to affect the aircrafts' roll and pitch which may comprise one or more ailerons. As a further example, flight component **632** may include a rudder to control yaw of an aircraft. In an embodiment, chipset component **628** may be configured to communicate with a plurality of flight components as a function of flight element **624**. For example, and without limitation, chipset component **628** may transmit to an aircraft rotor to reduce torque of a first lift propulsor and increase the forward thrust produced by a pusher component to perform a flight maneuver.

In an embodiment, and still referring to FIG. **6**, flight controller **604** may be configured generate an autonomous function. As used in this disclosure an "autonomous function" is a mode and/or function of flight controller **604** that controls aircraft automatically. For example, and without limitation, autonomous function may perform one or more aircraft maneuvers, take offs, landings, altitude adjustments, flight leveling adjustments, turns, climbs, and/or descents. As a further non-limiting example, autonomous function may adjust one or more airspeed velocities, thrusts, torques, and/or groundspeed velocities. As a further non-limiting example, autonomous function may perform one or more flight path corrections and/or flight path modifications as a function of flight element **624**. In an embodiment, autonomous function may include one or more modes of autonomy such as, but not limited to, autonomous mode, semi-autonomous mode, and/or non-autonomous mode. As used in this disclosure "autonomous mode" is a mode that automatically adjusts and/or controls aircraft and/or the maneuvers of aircraft in its entirety. For example, autonomous mode may denote that flight controller **604** will adjust the aircraft. As used in this disclosure a "semi-autonomous mode" is a mode that automatically adjusts and/or controls a portion and/or section of aircraft. For example, and without limitation, semi-autonomous mode may denote that a pilot will control the propulsors, wherein flight controller **604** will control the ailerons and/or rudders. As used in this disclosure "non-autonomous mode" is a mode that denotes a pilot will control aircraft and/or maneuvers of aircraft in its entirety.

In an embodiment, and still referring to FIG. **6**, flight controller **604** may generate autonomous function as a function of an autonomous machine-learning model. As used in this disclosure an "autonomous machine-learning

model" is a machine-learning model to produce an autonomous function output given flight element **624** and a pilot signal **636** as inputs; this is in contrast to a non-machine learning software program where the commands to be executed are determined in advance by a user and written in a programming language. In an embodiment, autonomous machine-learning model may be further configured to utilize the attachment datum as input. In embodiments, autonomous machine-learning model may be further configured to utilize the identification datum as input. In some embodiments autonomous machine-learning model may be further configured to utilize the attachment datum and identification datum as inputs. As used in this disclosure a "pilot signal" is an element of datum representing one or more functions a pilot is controlling and/or adjusting. For example, pilot signal **636** may denote that a pilot is controlling and/or maneuvering ailerons, wherein the pilot is not in control of the rudders and/or propulsors. In an embodiment, pilot signal **636** may include an implicit signal and/or an explicit signal. For example, and without limitation, pilot signal **636** may include an explicit signal, wherein the pilot explicitly states there is a lack of control and/or desire for autonomous function. As a further non-limiting example, pilot signal **636** may include an explicit signal directing flight controller **604** to control and/or maintain a portion of aircraft, a portion of the flight plan, the entire aircraft, and/or the entire flight plan. As a further non-limiting example, pilot signal **636** may include an implicit signal, wherein flight controller **604** detects a lack of control such as by a malfunction, torque alteration, flight path deviation, and the like thereof. In an embodiment, and without limitation, pilot signal **636** may include one or more explicit signals to reduce torque, and/or one or more implicit signals that torque may be reduced due to reduction of airspeed velocity. In an embodiment, and without limitation, pilot signal **636** may include one or more local and/or global signals. For example, and without limitation, pilot signal **636** may include a local signal that is transmitted by a pilot and/or crew member. As a further non-limiting example, pilot signal **636** may include a global signal that is transmitted by air traffic control and/or one or more remote users that are in communication with the pilot of aircraft. In an embodiment, pilot signal **636** may be received as a function of a tri-state bus and/or multiplexor that denotes an explicit pilot signal should be transmitted prior to any implicit or global pilot signal.

Still referring to FIG. **6**, autonomous machine-learning model may include one or more autonomous machine-learning processes such as supervised, unsupervised, or reinforcement machine-learning processes that flight controller **604** and/or a remote device may or may not use in the generation of autonomous function. As used in this disclosure "remote device" is an external device to flight controller **604**. Additionally or alternatively, autonomous machine-learning model may include one or more autonomous machine-learning processes that a field-programmable gate array (FPGA) may or may not use in the generation of autonomous function. Autonomous machine-learning process may include, without limitation machine learning processes such as simple linear regression, multiple linear regression, polynomial regression, support vector regression, ridge regression, lasso regression, elasticnet regression, decision tree regression, random forest regression, logistic regression, logistic classification, K-nearest neighbors, support vector machines, kernel support vector machines, naïve bayes, decision tree classification, random forest classification, K-means clustering, hierarchical clustering, dimensionality reduction, principal component analysis, linear discriminant analysis, kernel principal component analysis, Q-learning, State Action Reward State Action (SARSA), Deep-Q network, Markov decision processes, Deep Deterministic Policy Gradient (DDPG), or the like thereof.

In an embodiment, and still referring to FIG. **6**, autonomous machine learning model may be trained as a function of autonomous training data, wherein autonomous training data may correlate a flight element, pilot signal, and/or simulation data to an autonomous function. For example, and without limitation, a flight element of an airspeed velocity, a pilot signal of limited and/or no control of propulsors, and a simulation data of required airspeed velocity to reach the destination may result in an autonomous function that includes a semi-autonomous mode to increase thrust of the propulsors. Autonomous training data may be received as a function of user-entered valuations of flight elements, pilot signals, simulation data, and/or autonomous functions. Flight controller **604** may receive autonomous training data by receiving correlations of flight element, pilot signal, and/or simulation data to an autonomous function that were previously received and/or determined during a previous iteration of generation of autonomous function. Autonomous training data may be received by one or more remote devices and/or FPGAs that at least correlate a flight element, pilot signal, and/or simulation data to an autonomous function. Autonomous training data may be received in the form of one or more user-entered correlations of a flight element, pilot signal, and/or simulation data to an autonomous function.

Still referring to FIG. **6**, flight controller **604** may receive autonomous machine-learning model from a remote device and/or FPGA that utilizes one or more autonomous machine learning processes, wherein a remote device and an FPGA is described above in detail. For example, and without limitation, a remote device may include a computing device, external device, processor, FPGA, microprocessor and the like thereof. Remote device and/or FPGA may perform the autonomous machine-learning process using autonomous training data to generate autonomous function and transmit the output to flight controller **604**. Remote device and/or FPGA may transmit a signal, bit, datum, or parameter to flight controller **604** that at least relates to autonomous function. Additionally or alternatively, the remote device and/or FPGA may provide an updated machine-learning model. For example, and without limitation, an updated machine-learning model may be comprised of a firmware update, a software update, a autonomous machine-learning process correction, and the like thereof. As a non-limiting example a software update may incorporate a new simulation data that relates to a modified flight element. Additionally or alternatively, the updated machine learning model may be transmitted to the remote device and/or FPGA, wherein the remote device and/or FPGA may replace the autonomous machine-learning model with the updated machine-learning model and generate the autonomous function as a function of the flight element, pilot signal, and/or simulation data using the updated machine-learning model. The updated machine-learning model may be transmitted by the remote device and/or FPGA and received by flight controller **604** as a software update, firmware update, or corrected autonomous machine-learning model. For example, and without limitation autonomous machine learning model may utilize a neural net machine-learning process, wherein the updated machine-learning model may incorporate a gradient boosting machine-learning process.

Still referring to FIG. **6**, flight controller **604** may include, be included in, and/or communicate with a mobile device such as a mobile telephone or smartphone. Further, flight controller may communicate with one or more additional devices as described below in further detail via a network interface device. The network interface device may be utilized for commutatively connecting a flight controller to one or more of a variety of networks, and one or more devices. Examples of a network interface device include, but are not limited to, a network interface card (e.g., a mobile network interface card, a LAN card), a modem, and any combination thereof. Examples of a network include, but are not limited to, a wide area network (e.g., the Internet, an enterprise network), a local area network (e.g., a network associated with an office, a building, a campus or other relatively small geographic space), a telephone network, a data network associated with a telephone/voice provider (e.g., a mobile communications provider data and/or voice network), a direct connection between two computing devices, and any combinations thereof. The network may include any network topology and can may employ a wired and/or a wireless mode of communication.

In an embodiment, and still referring to FIG. **6**, flight controller **604** may include, but is not limited to, for example, a cluster of flight controllers in a first location and a second flight controller or cluster of flight controllers in a second location. Flight controller **604** may include one or more flight controllers dedicated to data storage, security, distribution of traffic for load balancing, and the like. Flight controller **604** may be configured to distribute one or more computing tasks as described below across a plurality of flight controllers, which may operate in parallel, in series, redundantly, or in any other manner used for distribution of tasks or memory between computing devices. For example, and without limitation, flight controller **604** may implement a control algorithm to distribute and/or command the plurality of flight controllers. As used in this disclosure a "control algorithm" is a finite sequence of well-defined computer implementable instructions that may determine the flight component of the plurality of flight components to be adjusted. For example, and without limitation, control algorithm may include one or more algorithms that reduce and/or prevent aviation asymmetry. As a further non-limiting example, control algorithms may include one or more models generated as a function of a software including, but not limited to Simulink by MathWorks, Natick, Massachusetts, USA. In an embodiment, and without limitation, control algorithm may be configured to generate an auto-code, wherein an "auto-code," is used herein, is a code and/or algorithm that is generated as a function of the one or more models and/or software's. In another embodiment, control algorithm may be configured to produce a segmented control algorithm. As used in this disclosure a "segmented control algorithm" is control algorithm that has been separated and/or parsed into discrete sections. For example, and without limitation, segmented control algorithm may parse control algorithm into two or more segments, wherein each segment of control algorithm may be performed by one or more flight controllers operating on distinct flight components.

In an embodiment, and still referring to FIG. **6**, control algorithm may be configured to determine a segmentation boundary as a function of segmented control algorithm. As used in this disclosure a "segmentation boundary" is a limit and/or delineation associated with the segments of the segmented control algorithm. For example, and without limitation, segmentation boundary may denote that a segment in the control algorithm has a first starting section and/or a first ending section. As a further non-limiting example, segmentation boundary may include one or more boundaries associated with an ability of flight component **632**. In an embodiment, control algorithm may be configured to create an optimized signal communication as a function of segmentation boundary. For example, and without limitation, optimized signal communication may include identifying the discrete timing required to transmit and/or receive the one or more segmentation boundaries. In an embodiment, and without limitation, creating optimized signal communication further comprises separating a plurality of signal codes across the plurality of flight controllers. For example, and without limitation the plurality of flight controllers may include one or more formal networks, wherein formal networks transmit data along an authority chain and/or are limited to task-related communications. As a further non-limiting example, communication network may include informal networks, wherein informal networks transmit data in any direction. In an embodiment, and without limitation, the plurality of flight controllers may include a chain path, wherein a "chain path," as used herein, is a linear communication path comprising a hierarchy that data may flow through. In an embodiment, and without limitation, the plurality of flight controllers may include an all-channel path, wherein an "all-channel path," as used herein, is a communication path that is not restricted to a particular direction. For example, and without limitation, data may be transmitted upward, downward, laterally, and the like thereof. In an embodiment, and without limitation, the plurality of flight controllers may include one or more neural networks that assign a weighted value to a transmitted datum. For example, and without limitation, a weighted value may be assigned as a function of one or more signals denoting that a flight component is malfunctioning and/or in a failure state.

Still referring to FIG. **6**, the plurality of flight controllers may include a master bus controller. As used in this disclosure a "master bus controller" is one or more devices and/or components that are connected to a bus to initiate a direct memory access transaction, wherein a bus is one or more terminals in a bus architecture. Master bus controller may communicate using synchronous and/or asynchronous bus control protocols. In an embodiment, master bus controller may include flight controller **604**. In another embodiment, master bus controller may include one or more universal asynchronous receiver-transmitters (UART). For example, and without limitation, master bus controller may include one or more bus architectures that allow a bus to initiate a direct memory access transaction from one or more buses in the bus architectures. As a further non-limiting example, master bus controller may include one or more peripheral devices and/or components to communicate with another peripheral device and/or component and/or the master bus controller. In an embodiment, master bus controller may be configured to perform bus arbitration. As used in this disclosure "bus arbitration" is method and/or scheme to prevent multiple buses from attempting to communicate with and/or connect to master bus controller. For example and without limitation, bus arbitration may include one or more schemes such as a small computer interface system, wherein a small computer interface system is a set of standards for physical connecting and transferring data between peripheral devices and master bus controller by defining commands, protocols, electrical, optical, and/or logical interfaces. In an embodiment, master bus controller may receive intermediate representation **612** and/or output language from logic compo-

nent **620**, wherein output language may include one or more analog-to-digital conversions, low bit rate transmissions, message encryptions, digital signals, binary signals, logic signals, analog signals, and the like thereof described above in detail.

Still referring to FIG. **6**, master bus controller may communicate with a slave bus. As used in this disclosure a "slave bus" is one or more peripheral devices and/or components that initiate a bus transfer. For example, and without limitation, slave bus may receive one or more controls and/or asymmetric communications from master bus controller, wherein slave bus transfers data stored to master bus controller. In an embodiment, and without limitation, slave bus may include one or more internal buses, such as but not limited to a/an internal data bus, memory bus, system bus, front-side bus, and the like thereof. In another embodiment, and without limitation, slave bus may include one or more external buses such as external flight controllers, external computers, remote devices, printers, aircraft computer systems, flight control systems, and the like thereof.

In an embodiment, and still referring to FIG. **6**, control algorithm may optimize signal communication as a function of determining one or more discrete timings. For example, and without limitation master bus controller may synchronize timing of the segmented control algorithm by injecting high priority timing signals on a bus of the master bus control. As used in this disclosure a "high priority timing signal" is information denoting that the information is important. For example, and without limitation, high priority timing signal may denote that a section of control algorithm is of high priority and should be analyzed and/or transmitted prior to any other sections being analyzed and/or transmitted. In an embodiment, high priority timing signal may include one or more priority packets. As used in this disclosure a "priority packet" is a formatted unit of data that is communicated between the plurality of flight controllers. For example, and without limitation, priority packet may denote that a section of control algorithm should be used and/or is of greater priority than other sections.

Still referring to FIG. **6**, flight controller **604** may also be implemented using a "shared nothing" architecture in which data is cached at the worker, in an embodiment, this may enable scalability of aircraft and/or computing device. Flight controller **604** may include a distributer flight controller. As used in this disclosure a "distributer flight controller" is a component that adjusts and/or controls a plurality of flight components as a function of a plurality of flight controllers. For example, distributer flight controller may include a flight controller that communicates with a plurality of additional flight controllers and/or clusters of flight controllers. In an embodiment, distributed flight control may include one or more neural networks. For example, neural network also known as an artificial neural network, is a network of "nodes," or data structures having one or more inputs, one or more outputs, and a function determining outputs based on inputs. Such nodes may be organized in a network, such as without limitation a convolutional neural network, including an input layer of nodes, one or more intermediate layers, and an output layer of nodes. Connections between nodes may be created via the process of "training" the network, in which elements from a training dataset are applied to the input nodes, a suitable training algorithm (such as Levenberg-Marquardt, conjugate gradient, simulated annealing, or other algorithms) is then used to adjust the connections and weights between nodes in adjacent layers of the neural network to produce the desired values at the output nodes. This process is sometimes referred to as deep learning.

Still referring to FIG. **6**, a node may include, without limitation a plurality of inputs x_i that may receive numerical values from inputs to a neural network containing the node and/or from other nodes. Node may perform a weighted sum of inputs using weights w_i that are multiplied by respective inputs x_i. Additionally or alternatively, a bias b may be added to the weighted sum of the inputs such that an offset is added to each unit in the neural network layer that is independent of the input to the layer. The weighted sum may then be input into a function φ, which may generate one or more outputs y. Weight w_i applied to an input x_i may indicate whether the input is "excitatory," indicating that it has strong influence on the one or more outputs y, for instance by the corresponding weight having a large numerical value, and/or a "inhibitory," indicating it has a weak effect influence on the one more inputs y, for instance by the corresponding weight having a small numerical value. The values of weights w_i may be determined by training a neural network using training data, which may be performed using any suitable process as described above. In an embodiment, and without limitation, a neural network may receive semantic units as inputs and output vectors representing such semantic units according to weights w_i that are derived using machine-learning processes as described in this disclosure.

Still referring to FIG. **6**, flight controller may include a sub-controller **640**. As used in this disclosure a "sub-controller" is a controller and/or component that is part of a distributed controller as described above; for instance, flight controller **604** may be and/or include a distributed flight controller made up of one or more sub-controllers. For example, and without limitation, sub-controller **640** may include any controllers and/or components thereof that are similar to distributed flight controller and/or flight controller as described above. Sub-controller **640** may include any component of any flight controller as described above. Sub-controller **640** may be implemented in any manner suitable for implementation of a flight controller as described above. As a further non-limiting example, sub-controller **640** may include one or more processors, logic components and/or computing devices capable of receiving, processing, and/or transmitting data across the distributed flight controller as described above. As a further non-limiting example, sub-controller **640** may include a controller that receives a signal from a first flight controller and/or first distributed flight controller component and transmits the signal to a plurality of additional sub-controllers and/or flight components.

Still referring to FIG. **6**, flight controller may include a co-controller **644**. As used in this disclosure a "co-controller" is a controller and/or component that joins flight controller **604** as components and/or nodes of a distributer flight controller as described above. For example, and without limitation, co-controller **644** may include one or more controllers and/or components that are similar to flight controller **604**. As a further non-limiting example, co-controller **644** may include any controller and/or component that joins flight controller **604** to distributer flight controller. As a further non-limiting example, co-controller **644** may include one or more processors, logic components and/or computing devices capable of receiving, processing, and/or transmitting data to and/or from flight controller **604** to distributed flight control system. Co-controller **644** may include any component of any flight controller as described above. Co-controller **644** may be implemented in any manner suitable for implementation of a flight controller as described above.

In an embodiment, and with continued reference to FIG. **6**, flight controller **604** may be designed and/or configured to

perform any method, method step, or sequence of method steps in any embodiment described in this disclosure, in any order and with any degree of repetition. For instance, flight controller **604** may be configured to perform a single step or sequence repeatedly until a desired or commanded outcome is achieved; repetition of a step or a sequence of steps may be performed iteratively and/or recursively using outputs of previous repetitions as inputs to subsequent repetitions, aggregating inputs and/or outputs of repetitions to produce an aggregate result, reduction or decrement of one or more variables such as global variables, and/or division of a larger processing task into a set of iteratively addressed smaller processing tasks. Flight controller may perform any step or sequence of steps as described in this disclosure in parallel, such as simultaneously and/or substantially simultaneously performing a step two or more times using two or more parallel threads, processor cores, or the like; division of tasks between parallel threads and/or processes may be performed according to any protocol suitable for division of tasks between iterations. Persons skilled in the art, upon reviewing the entirety of this disclosure, will be aware of various ways in which steps, sequences of steps, processing tasks, and/or data may be subdivided, shared, or otherwise dealt with using iteration, recursion, and/or parallel processing.

Referring now to FIG. **7**, an exemplary embodiment of a machine-learning module **700** that may perform one or more machine-learning processes as described in this disclosure is illustrated. Machine-learning module may perform determinations, classification, and/or analysis steps, methods, processes, or the like as described in this disclosure using machine learning processes. A "machine learning process," as used in this disclosure, is a process that automatedly uses training data **704** to generate an algorithm that will be performed by a computing device/module to produce outputs **708** given data provided as inputs **712**; this is in contrast to a non-machine learning software program where the commands to be executed are determined in advance by a user and written in a programming language. In an embodiment, machine learning process may generate an authentication algorithm to produce verification datum outputs given identification datum and attachment datum as inputs.

Still referring to FIG. **7**, "training data," as used herein, is data containing correlations that a machine-learning process may use to model relationships between two or more categories of data elements. For instance, and without limitation, training data **704** may include a plurality of data entries, each entry representing a set of data elements that were recorded, received, and/or generated together; data elements may be correlated by shared existence in a given data entry, by proximity in a given data entry, or the like. Multiple data entries in training data **704** may evince one or more trends in correlations between categories of data elements; for instance, and without limitation, a higher value of a first data element belonging to a first category of data element may tend to correlate to a higher value of a second data element belonging to a second category of data element, indicating a possible proportional or other mathematical relationship linking values belonging to the two categories. Multiple categories of data elements may be related in training data **704** according to various correlations; correlations may indicate causative and/or predictive links between categories of data elements, which may be modeled as relationships such as mathematical relationships by machine-learning processes as described in further detail below. Training data **704** may be formatted and/or organized by categories of data elements, for instance by associating data elements with one or more descriptors corresponding to categories of data elements. As a non-limiting example, training data **704** may include data entered in standardized forms by persons or processes, such that entry of a given data element in a given field in a form may be mapped to one or more descriptors of categories. Elements in training data **704** may be linked to descriptors of categories by tags, tokens, or other data elements; for instance, and without limitation, training data **704** may be provided in fixed-length formats, formats linking positions of data to categories such as comma-separated value (CSV) formats and/or self-describing formats such as extensible markup language (XML), JavaScript Object Notation (JSON), or the like, enabling processes or devices to detect categories of data.

Alternatively or additionally, and continuing to refer to FIG. **7**, training data **704** may include one or more elements that are not categorized; that is, training data **704** may not be formatted or contain descriptors for some elements of data. Machine-learning algorithms and/or other processes may sort training data **704** according to one or more categorizations using, for instance, natural language processing algorithms, tokenization, detection of correlated values in raw data and the like; categories may be generated using correlation and/or other processing algorithms. As a non-limiting example, in a corpus of text, phrases making up a number "n" of compound words, such as nouns modified by other nouns, may be identified according to a statistically significant prevalence of n-grams containing such words in a particular order; such an n-gram may be categorized as an element of language such as a "word" to be tracked similarly to single words, generating a new category as a result of statistical analysis. Similarly, in a data entry including some textual data, a person's name may be identified by reference to a list, dictionary, or other compendium of terms, permitting ad-hoc categorization by machine-learning algorithms, and/or automated association of data in the data entry with descriptors or into a given format. The ability to categorize data entries automatedly may enable the same training data **704** to be made applicable for two or more distinct machine-learning algorithms as described in further detail below. Training data **704** used by machine-learning module **700** may correlate any input data as described in this disclosure to any output data as described in this disclosure. As a non-limiting illustrative example flight elements and/or pilot signals may be inputs, wherein an output may be an autonomous function.

Further referring to FIG. **7**, training data may be filtered, sorted, and/or selected using one or more supervised and/or unsupervised machine-learning processes and/or models as described in further detail below; such models may include without limitation a training data classifier **716**. Training data classifier **716** may include a "classifier," which as used in this disclosure is a machine-learning model as defined below, such as a mathematical model, neural net, or program generated by a machine learning algorithm known as a "classification algorithm," as described in further detail below, that sorts inputs into categories or bins of data, outputting the categories or bins of data and/or labels associated therewith. A classifier may be configured to output at least a datum that labels or otherwise identifies a set of data that are clustered together, found to be close under a distance metric as described below, or the like. Machine-learning module **700** may generate a classifier using a classification algorithm, defined as a processes whereby a computing device and/or any module and/or component operating thereon derives a classifier from training data **704**. Classification may be performed using, with-

out limitation, linear classifiers such as without limitation logistic regression and/or naive Bayes classifiers, nearest neighbor classifiers such as k-nearest neighbors classifiers, support vector machines, least squares support vector machines, fisher's linear discriminant, quadratic classifiers, decision trees, boosted trees, random forest classifiers, learning vector quantization, and/or neural network-based classifiers. As a non-limiting example, training data classifier **716** may classify elements of training data to sub-categories of flight elements such as torques, forces, thrusts, directions, and the like thereof.

Still referring to FIG. **7**, machine-learning module **700** may be configured to perform a lazy-learning process **720** and/or protocol, which may alternatively be referred to as a "lazy loading" or "call-when-needed" process and/or protocol, may be a process whereby machine learning is conducted upon receipt of an input to be converted to an output, by combining the input and training set to derive the algorithm to be used to produce the output on demand. For instance, an initial set of simulations may be performed to cover an initial heuristic and/or "first guess" at an output and/or relationship. As a non-limiting example, an initial heuristic may include a ranking of associations between inputs and elements of training data **704**. Heuristic may include selecting some number of highest-ranking associations and/or training data **704** elements. Lazy learning may implement any suitable lazy learning algorithm, including without limitation a K-nearest neighbors algorithm, a lazy naïve Bayes algorithm, or the like; persons skilled in the art, upon reviewing the entirety of this disclosure, will be aware of various lazy-learning algorithms that may be applied to generate outputs as described in this disclosure, including without limitation lazy learning applications of machine-learning algorithms as described in further detail below.

Alternatively or additionally, and with continued reference to FIG. **7**, machine-learning processes as described in this disclosure may be used to generate machine-learning models **724**. A "machine-learning model," as used in this disclosure, is a mathematical and/or algorithmic representation of a relationship between inputs and outputs, as generated using any machine-learning process including without limitation any process as described above, and stored in memory; an input is submitted to a machine-learning model **724** once created, which generates an output based on the relationship that was derived. For instance, and without limitation, a linear regression model, generated using a linear regression algorithm, may compute a linear combination of input data using coefficients derived during machine-learning processes to calculate an output datum. As a further non-limiting example, a machine-learning model **724** may be generated by creating an artificial neural network, such as a convolutional neural network comprising an input layer of nodes, one or more intermediate layers, and an output layer of nodes. Connections between nodes may be created via the process of "training" the network, in which elements from a training data **704** set are applied to the input nodes, a suitable training algorithm (such as Levenberg-Marquardt, conjugate gradient, simulated annealing, or other algorithms) is then used to adjust the connections and weights between nodes in adjacent layers of the neural network to produce the desired values at the output nodes. This process is sometimes referred to as deep learning.

Still referring to FIG. **7**, machine-learning algorithms may include at least a supervised machine-learning process **728**. At least a supervised machine-learning process **728**, as defined herein, include algorithms that receive a training set relating a number of inputs to a number of outputs, and seek to find one or more mathematical relations relating inputs to outputs, where each of the one or more mathematical relations is optimal according to some criterion specified to the algorithm using some scoring function. For instance, a supervised learning algorithm may include flight elements and/or pilot signals as described above as inputs, autonomous functions as outputs, and a scoring function representing a desired form of relationship to be detected between inputs and outputs; scoring function may, for instance, seek to maximize the probability that a given input and/or combination of elements inputs is associated with a given output to minimize the probability that a given input is not associated with a given output. Scoring function may be expressed as a risk function representing an "expected loss" of an algorithm relating inputs to outputs, where loss is computed as an error function representing a degree to which a prediction generated by the relation is incorrect when compared to a given input-output pair provided in training data **704**. Persons skilled in the art, upon reviewing the entirety of this disclosure, will be aware of various possible variations of at least a supervised machine-learning process **728** that may be used to determine relation between inputs and outputs. Supervised machine-learning processes may include classification algorithms as defined above.

Further referring to FIG. **7**, machine learning processes may include at least an unsupervised machine-learning processes **732**. An unsupervised machine-learning process, as used herein, is a process that derives inferences in datasets without regard to labels; as a result, an unsupervised machine-learning process may be free to discover any structure, relationship, and/or correlation provided in the data. Unsupervised processes may not require a response variable; unsupervised processes may be used to find interesting patterns and/or inferences between variables, to determine a degree of correlation between two or more variables, or the like.

Still referring to FIG. **7**, machine-learning module **700** may be designed and configured to create a machine-learning model **724** using techniques for development of linear regression models. Linear regression models may include ordinary least squares regression, which aims to minimize the square of the difference between predicted outcomes and actual outcomes according to an appropriate norm for measuring such a difference (e.g. a vector-space distance norm); coefficients of the resulting linear equation may be modified to improve minimization. Linear regression models may include ridge regression methods, where the function to be minimized includes the least-squares function plus term multiplying the square of each coefficient by a scalar amount to penalize large coefficients. Linear regression models may include least absolute shrinkage and selection operator (LASSO) models, in which ridge regression is combined with multiplying the least-squares term by a factor of 1 divided by double the number of samples. Linear regression models may include a multi-task lasso model wherein the norm applied in the least-squares term of the lasso model is the Frobenius norm amounting to the square root of the sum of squares of all terms. Linear regression models may include the elastic net model, a multi-task elastic net model, a least angle regression model, a LARS lasso model, an orthogonal matching pursuit model, a Bayesian regression model, a logistic regression model, a stochastic gradient descent model, a perceptron model, a passive aggressive algorithm, a robustness regression model, a Huber regression model, or any other suitable model that may occur to persons skilled in the art upon reviewing the entirety of this disclosure. Linear regression

models may be generalized in an embodiment to polynomial regression models, whereby a polynomial equation (e.g. a quadratic, cubic or higher-order equation) providing a best predicted output/actual output fit is sought; similar methods to those described above may be applied to minimize error functions, as will be apparent to persons skilled in the art upon reviewing the entirety of this disclosure.

Continuing to refer to FIG. **7**, machine-learning algorithms may include, without limitation, linear discriminant analysis. Machine-learning algorithm may include quadratic discriminate analysis. Machine-learning algorithms may include kernel ridge regression. Machine-learning algorithms may include support vector machines, including without limitation support vector classification-based regression processes. Machine-learning algorithms may include stochastic gradient descent algorithms, including classification and regression algorithms based on stochastic gradient descent. Machine-learning algorithms may include nearest neighbors algorithms. Machine-learning algorithms may include Gaussian processes such as Gaussian Process Regression. Machine-learning algorithms may include cross-decomposition algorithms, including partial least squares and/or canonical correlation analysis. Machine-learning algorithms may include naïve Bayes methods. Machine-learning algorithms may include algorithms based on decision trees, such as decision tree classification or regression algorithms. Machine-learning algorithms may include ensemble methods such as bagging meta-estimator, forest of randomized tress, AdaBoost, gradient tree boosting, and/or voting classifier methods. Machine-learning algorithms may include neural net algorithms, including convolutional neural net processes.

Referring now to FIG. **8**, an embodiment of unsupervised machine-learning model **124** is illustrated. Unsupervised learning may include any of the unsupervised learning processes as described herein. Unsupervised machine-learning model **124** includes any clustering unsupervised machine-learning model as described herein. Unsupervised machine-learning model **124** generates at least a second correlated identification data **800**. The at least a second correlated identification data **800** is generated as a function of the authentication datum **804** and the correlated dataset. Correlated dataset may be selected from data store system **120** as described herein. Data store system **120** may contain data describing different characteristics of authentication datum **804**, such as user identifiers, vehicle identifiers, and the like, which may be organized into categories contained within data store system **120**. Unsupervised machine-learning model may further include a hierarchical clustering model **808**. Hierarchical clustering model **808** may group and/or segment datasets into hierarchy clusters including both agglomerative and divisive clusters. Agglomerative clusters may include a bottom up approach where each observation starts in its own cluster and pairs of clusters are merged as one moves up the hierarchy. Divisive clusters may include a top down approach where all observations may start in one cluster and splits are performed recursively as one moves down the hierarchy. In an embodiment, hierarchical clustering model **808** may analyze datasets obtained from data store system **120** to find observations which may each initially form own cluster. Hierarchical clustering model **808** may then then identify clusters that are closest together and merge the two most similar clusters and continue until all clusters are merged together. Hierarchical clustering model **808** may output a dendrogram which may describe the hierarchical relationship between the clusters. Distance between clusters that are created may be measured using a suitable metric. Distance may be measured between for example the two most similar parts of a cluster known as single linkage, the two least similar bits of a cluster known as complete-linkage, the center of the clusters known as average-linkage or by some other criterion which may be obtained based on input received from data store system **120**, as an example.

With continued reference to FIG. **8**, unsupervised machine-learning model **124** may perform other unsupervised machine learning models to output identification data **800**. Unsupervised machine-learning model **124** may include a data clustering model **812**. Data clustering model **812** may group and/or segment datasets with shared attributes to extrapolate algorithmic relationships. Data clustering model **812** may group data that has been labelled, classified, and/or categorized. Data clustering model **812** may identify commonalities in data and react based on the presence or absence of such commonalities. For instance, and without limitation, data clustering model **712** may identify other data sets that contain the same or similar characteristics of the user identifier contained within authentication datum **804** or identify other datasets that contain parts with similar attributes and/or differentiations. In an embodiment, data clustering model **812** may cluster data and generate labels that may be utilized as training set data. Data clustering model **812** may utilize other forms of data clustering algorithms including for example, hierarchical clustering, k-means, mixture models, OPTICS algorithm, and DBSCAN.

With continued reference to FIG. **8**, unsupervised machine-learning model **124** may include an anomaly detection model **816**, Anomaly detection model **816** may include identification of rare events or observations that differ significant from the majority of the data. Anomaly detection model **816** may function to observe and find outliers. For instance, and without limitation, anomaly detect may find and examine data outliers such as a user identifier that is not compatible with any identifier or that is compatible with very few identifiers.

Still referring to FIG. **8**, unsupervised machine-learning model **124** may include other unsupervised machine-learning models **820**. This may include for example, neural networks, autoencoders, deep belief nets, Hebbian learning, adversarial networks, self-organizing maps, expectation-maximization algorithm, method of moments, blind signal separation techniques, principal component analysis, independent component analysis, non-negative matrix factorization, singular value decomposition (not pictured).

It is to be noted that any one or more of the aspects and embodiments described herein may be conveniently implemented using one or more machines (e.g., one or more computing devices that are utilized as a user computing device for an electronic document, one or more server devices, such as a document server, etc.) programmed according to the teachings of the present specification, as will be apparent to those of ordinary skill in the computer art. Appropriate software coding can readily be prepared by skilled programmers based on the teachings of the present disclosure, as will be apparent to those of ordinary skill in the software art. Aspects and implementations discussed above employing software and/or software modules may also include appropriate hardware for assisting in the implementation of the machine executable instructions of the software and/or software module.

Such software may be a computer program product that employs a machine-readable storage medium. A machine-readable storage medium may be any medium that is capable

of storing and/or encoding a sequence of instructions for execution by a machine (e.g., a computing device) and that causes the machine to perform any one of the methodologies and/or embodiments described herein. Examples of a machine-readable storage medium include, but are not limited to, a magnetic disk, an optical disc (e.g., CD, CD-R, DVD, DVD-R, etc.), a magneto-optical disk, a read-only memory "ROM" device, a random access memory "RAM" device, a magnetic card, an optical card, a solid-state memory device, an EPROM, an EEPROM, and any combinations thereof. A machine-readable medium, as used herein, is intended to include a single medium as well as a collection of physically separate media, such as, for example, a collection of compact discs or one or more hard disk drives in combination with a computer memory. As used herein, a machine-readable storage medium does not include transitory forms of signal transmission.

Such software may also include information (e.g., data) carried as a data signal on a data carrier, such as a carrier wave. For example, machine-executable information may be included as a data-carrying signal embodied in a data carrier in which the signal encodes a sequence of instruction, or portion thereof, for execution by a machine (e.g., a computing device) and any related information (e.g., data structures and data) that causes the machine to perform any one of the methodologies and/or embodiments described herein.

Examples of a computing device include, but are not limited to, an electronic book reading device, a computer workstation, a terminal computer, a server computer, a handheld device (e.g., a tablet computer, a smartphone, etc.), a web appliance, a network router, a network switch, a network bridge, any machine capable of executing a sequence of instructions that specify an action to be taken by that machine, and any combinations thereof. In one example, a computing device may include and/or be included in a kiosk.

FIG. **9** shows a diagrammatic representation of one embodiment of a computing device in the exemplary form of a computer system **900** within which a set of instructions for causing a control system to perform any one or more of the aspects and/or methodologies of the present disclosure may be executed. It is also contemplated that multiple computing devices may be utilized to implement a specially configured set of instructions for causing one or more of the devices to perform any one or more of the aspects and/or methodologies of the present disclosure. Computer system **900** includes a processor **904** and a memory **908** that communicate with each other, and with other components, via a bus **912**. Bus **912** may include any of several types of bus structures including, but not limited to, a memory bus, a memory controller, a peripheral bus, a local bus, and any combinations thereof, using any of a variety of bus architectures.

Processor **904** may include any suitable processor, such as without limitation a processor incorporating logical circuitry for performing arithmetic and logical operations, such as an arithmetic and logic unit (ALU), which may be regulated with a state machine and directed by operational inputs from memory and/or sensors; processor **904** may be organized according to Von Neumann and/or Harvard architecture as a non-limiting example. Processor **904** may include, incorporate, and/or be incorporated in, without limitation, a microcontroller, microprocessor, digital signal processor (DSP), Field Programmable Gate Array (FPGA), Complex Programmable Logic Device (CPLD), Graphical Processing Unit (GPU), general purpose GPU, Tensor Processing Unit (TPU), analog or mixed signal processor, Trusted Platform Module (TPM), a floating point unit (FPU), and/or system on a chip (SoC).

Memory **908** may include various components (e.g., machine-readable media) including, but not limited to, a random-access memory component, a read only component, and any combinations thereof. In one example, a basic input/output system **916** (BIOS), including basic routines that help to transfer information between elements within computer system **900**, such as during start-up, may be stored in memory **908**. Memory **908** may also include (e.g., stored on one or more machine-readable media) instructions (e.g., software) **920** embodying any one or more of the aspects and/or methodologies of the present disclosure. In another example, memory **908** may further include any number of program modules including, but not limited to, an operating system, one or more application programs, other program modules, program data, and any combinations thereof.

Computer system **900** may also include a storage device **924**. Examples of a storage device (e.g., storage device **924**) include, but are not limited to, a hard disk drive, a magnetic disk drive, an optical disc drive in combination with an optical medium, a solid-state memory device, and any combinations thereof. Storage device **924** may be connected to bus **912** by an appropriate interface (not shown). Example interfaces include, but are not limited to, SCSI, advanced technology attachment (ATA), serial ATA, universal serial bus (USB), IEEE 1394 (FIREWIRE), and any combinations thereof. In one example, storage device **924** (or one or more components thereof) may be removably interfaced with computer system **900** (e.g., via an external port connector (not shown)). Particularly, storage device **924** and an associated machine-readable medium **928** may provide nonvolatile and/or volatile storage of machine-readable instructions, data structures, program modules, and/or other data for computer system **900**. In one example, software **920** may reside, completely or partially, within machine-readable medium **928**. In another example, software **920** may reside, completely or partially, within processor **904**.

Computer system **900** may also include an input device **932**. In one example, a user of computer system **900** may enter commands and/or other information into computer system **900** via input device **932**. Examples of an input device **932** include, but are not limited to, an alpha-numeric input device (e.g., a keyboard), a pointing device, a joystick, a gamepad, an audio input device (e.g., a microphone, a voice response system, etc.), a cursor control device (e.g., a mouse), a touchpad, an optical scanner, a video capture device (e.g., a still camera, a video camera), a touchscreen, and any combinations thereof. Input device **932** may be interfaced to bus **912** via any of a variety of interfaces (not shown) including, but not limited to, a serial interface, a parallel interface, a game port, a USB interface, a FIREWIRE interface, a direct interface to bus **912**, and any combinations thereof. Input device **932** may include a touch screen interface that may be a part of or separate from display **936**, discussed further below. Input device **932** may be utilized as a user selection device for selecting one or more graphical representations in a graphical interface as described above.

A user may also input commands and/or other information to computer system **900** via storage device **924** (e.g., a removable disk drive, a flash drive, etc.) and/or network interface device **940**. A network interface device, such as network interface device **940**, may be utilized for connecting computer system **900** to one or more of a variety of networks, such as network **944**, and one or more remote

devices **948** connected thereto. Examples of a network interface device include, but are not limited to, a network interface card (e.g., a mobile network interface card, a LAN card), a modem, and any combination thereof. Examples of a network include, but are not limited to, a wide area network (e.g., the Internet, an enterprise network), a local area network (e.g., a network associated with an office, a building, a campus or other relatively small geographic space), a telephone network, a data network associated with a telephone/voice provider (e.g., a mobile communications provider data and/or voice network), a direct connection between two computing devices, and any combinations thereof. A network, such as network **944**, may employ a wired and/or a wireless mode of communication. In general, any network topology may be used. Information (e.g., data, software **920**, etc.) may be communicated to and/or from computer system **900** via network interface device **940**.

Computer system **900** may further include a video display adapter **952** for communicating a displayable image to a display device, such as display device **936**. Examples of a display device include, but are not limited to, a liquid crystal display (LCD), a cathode ray tube (CRT), a plasma display, a light emitting diode (LED) display, and any combinations thereof. Display adapter **952** and display device **936** may be utilized in combination with processor **904** to provide graphical representations of aspects of the present disclosure. In addition to a display device, computer system **900** may include one or more other peripheral output devices including, but not limited to, an audio speaker, a printer, and any combinations thereof. Such peripheral output devices may be connected to bus **912** via a peripheral interface **956**. Examples of a peripheral interface include, but are not limited to, a serial port, a USB connection, a FIREWIRE connection, a parallel connection, and any combinations thereof.

The foregoing has been a detailed description of illustrative embodiments of the invention. Various modifications and additions can be made without departing from the spirit and scope of this invention. Features of each of the various embodiments described above may be combined with features of other described embodiments as appropriate in order to provide a multiplicity of feature combinations in associated new embodiments. Furthermore, while the foregoing describes a number of separate embodiments, what has been described herein is merely illustrative of the application of the principles of the present invention. Additionally, although particular methods herein may be illustrated and/or described as being performed in a specific order, the ordering is highly variable within ordinary skill to achieve methods, systems, and software according to the present disclosure. Accordingly, this description is meant to be taken only by way of example, and not to otherwise limit the scope of this invention.

Exemplary embodiments have been disclosed above and illustrated in the accompanying drawings. It will be understood by those skilled in the art that various changes, omissions and additions may be made to that which is specifically disclosed herein without departing from the spirit and scope of the present invention.

What is claimed is:

1. A connector for charging an electric aircraft, wherein the connector comprises:

at least a sensor, wherein the at least a sensor is configured to detect an attachment datum; and

a computing device, wherein the computing device is configured to:

receive the attachment datum from the at least a sensor;

generate a verification datum as a function of an identification datum and the attachment datum, wherein the identification datum identifies the electric aircraft, and wherein generating the verification datum further comprises:

selecting a correlated dataset containing a plurality of data entries wherein each dataset contains at least a datum of identification data and at least a first correlated authentication datum; and

generating, at a clustering unsupervised machine-learning model, the verification datum as a function of the attachment datum, the identification datum and the correlated dataset; and

determine an authorization status as a function of the verification datum.

2. The connector of claim **1**, wherein generating the verification datum further comprises:

receiving an identification datum from the electric aircraft; and

generating the verification datum as a function of the identification datum.

3. The connector of claim **1**, wherein the at least a sensor further comprises at least a proximity sensor.

4. The connector of claim **1**, wherein the connector further comprises at least a direct current conductor, wherein the at least a direct current conductor is configured to conduct a direct current.

5. The connector of claim **1**, wherein the connector further comprises at least a control signal conductor, wherein the at least a control signal conductor is configured to conduct a control signal.

6. The connector of claim **5**, wherein the connector further comprises at least a ground conductor, wherein the at least a ground conductor is configured to conduct to a ground.

7. The connector of claim **1**, wherein the connector further comprises a fastener for removable attachment with the electric vehicle port.

8. The connector of claim **1** further comprising an isolation monitor conductor configured to conduct an isolation monitoring signal.

9. The connector of claim **1**, wherein the computing device is further configured to transmit the authorization status to a user device.

10. The connector of claim **1**, wherein the connector comprises a housing configured to mate with a test port.

11. The connector of claim **1**, wherein the connector comprises an interlocking mechanism.

12. The connector of claim **11**, wherein the at least a sensor is further configured to detect the attachment datum as a function of the interlocking mechanism.

13. A method for charging an electric aircraft, the method comprising:

detecting, by at least a sensor of a connector, wherein the at least a sensor is configured to detect an attachment datum;

receiving, at a computing device, the attachment datum from the at least a sensor;

generating, at the computing device, a verification datum as a function of an identification datum and the attachment datum, wherein the identification datum identifies the electric aircraft, and wherein generating the verification datum further comprises:

selecting a correlated dataset containing a plurality of data entries wherein each dataset contains at least a datum of identification data and at least a first correlated authentication datum; and

generating, at a clustering unsupervised machine-learning model, the verification datum as a function of the attachment datum, the identification datum and the correlated dataset; and

determining, at the computing device, an authorization status as a function of the verification datum.

14. The method of claim **13**, wherein the method further comprises transmitting, by the computing device, the authorization status to a user device.

15. The method of claim **13**, wherein the method further comprises storing, by the computing device, the identification datum in a data store system.

16. The method of claim **13**, wherein the method further comprises storing, by the computing device, the authorization status in a data store system.

17. The method of claim **13**, wherein generating, at the computing device, the verification datum comprises utilizing an authentication broker.

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